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Recent Destroyer Construction

By M. K. Barnett

IN the composition of any fleet, all experts are unanimous in recognizing the need of a large number of torpedo-boat destroyers. In fact, at the commencement of the present war, Britain, although possessing a large number of these vessels, found the amount inadequate to cope with the exigencies she was called upon to meet. Many more destroyers, therefore, were immediately constructed, and a rapid output is still being maintained.

Destroyer type is governed by the incorporation, to a greater or less degree, of the elemental qualities of the type. These roughly are four. Armament—including of course, torpedo-tubes—speed, robustness, and fuel capacity.

For purpose of illustration I am taking the French destroyers of the "Bisson" class—the Russian "Novik," and the German "S-9."

The "Bisson," with tonnage of 750, carries two 4-inch, four 9-pounder guns and four 18-inch tubes in pairs. Her engines of 15,000 horse-power give her a speed of 31 knots while she has a cruising radius of 1,170 knots at 14 and 2,300 knots at 10 knots per hour. This type has a fairly heavy armament but not a very high speed, and although not very large her high fo'cstle makes her seaworthy. She represents a good development of the four qualities on a small tonnage. A small tonnage, that is to say, when compared with such destroyers as the "Novik."

These latter vessels, of which a large number have been constructed by Russia, displace 1,260 tons; their turbine engines of 40,000 horse-power give them a speed of 36 knots. Four 4.1 inch, and four machine guns are mounted, and they carry four single, 18-inch torpedo tubes. Oil fuel only is burned and they command a large cruising radius. This is an example of the large destroyer the size of which, while increasing the structural strength, allows for the installation of powerful engines and a heavy armament.

The third type is the "S-9." She displaces 820 tons and her engines of 15,000 horse-power give her a speed of 32-35 knots. The most interesting feature of this destroyer, however, is her armament. While carrying only two 24-pounder (3.5 inch) and four machine guns, she mounts four pairs of 20-inch torpedo tubes. Space is allotted for 200 tons of coal and 70 tons of oil, giving her a fairly large cruising radius. This type marks a sacrifice of guns in favor of torpedo tubes. In fact she might almost be termed an "ocean-going torpedo-boat," for an exceptionally high fo'cstle is provided for seaworthiness.

The present day functions of the destroyer are numerous. Besides her original *metier* of destroying torpedo boats, and the assumption of the torpedo boats' duty (the attacking of larger ships with the torpedo,) she is invaluable in forming a screen to protect a battle fleet from submarine attack. She is also indispensible for patrolling, reconnoitering, convoying, and hunting the submarine. In addition she has, at a pinch, been used in mine-sweeping. The modern destroyer is no fair-weather craft, and her many duties have necessitated great increase in size and seaworthiness.

Which is the more efficient type—the destroyer of about 750 tons or her larger contemporaries of 1200 tons odd?

The former is the less costly, carries a smaller crew, is more agile, has a lighter draft, and also presents a smaller target to gun and torpedo.

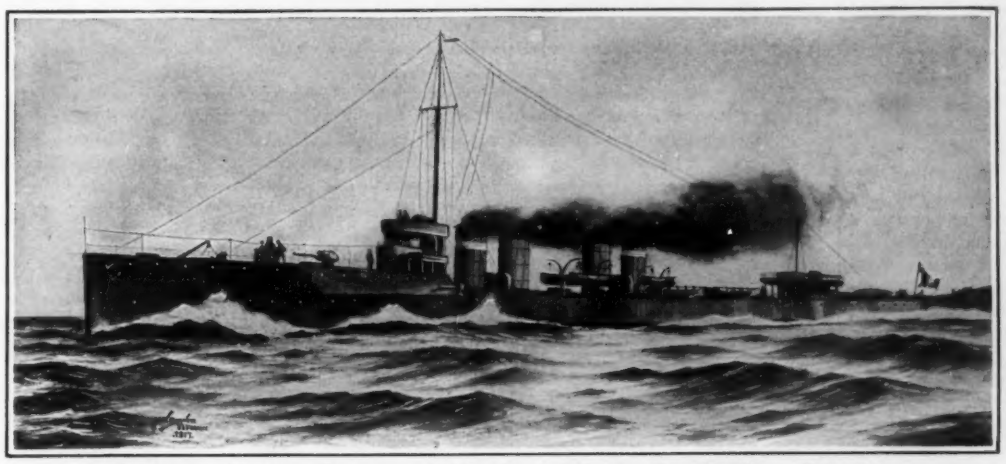
The larger destroyer is enabled by her size to carry a heavier armament, more powerful engines, and also has greater structural strength, seaworthiness and fuel capacity.

On the strength of lessons learned during the war, opinion seems to favor the larger type. But, if the destroyer continues to advance in size, will not the type soon fuse with that of the fast, light scout? Already a split has occurred in two of the largest navies, destroyers of specially large tonnage being termed and used as "flotilla leaders."

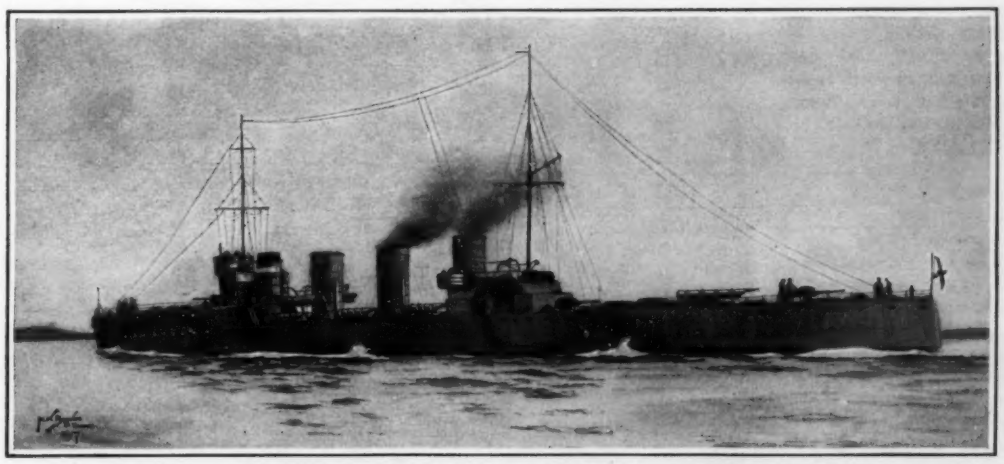
One of two things seems likely. Either the so-called flotilla-leader will eventually fuse with the fast light scout, in which case the latter vessel might act as "flotilla leader" to destroyers of enlarged tonnage; or else, the increase of robustness in flotillas will gradually do away with the need of a "flotilla leader," and thus eliminate what threatens to become a new type. Of these two alternatives I should consider the latter the more probable.

America in her new naval program has provided for destroyers of 1,185 tons. These will attain a speed of 35 knots and will mount four 4-inch, two anti-aircraft guns and four triple torpedo tubes. They will also have a very extensive cruising radius. Obviously this is a very powerful type with armament, speed, robustness and fuel capacity developed to a commendable degree on the fairly large tonnage.

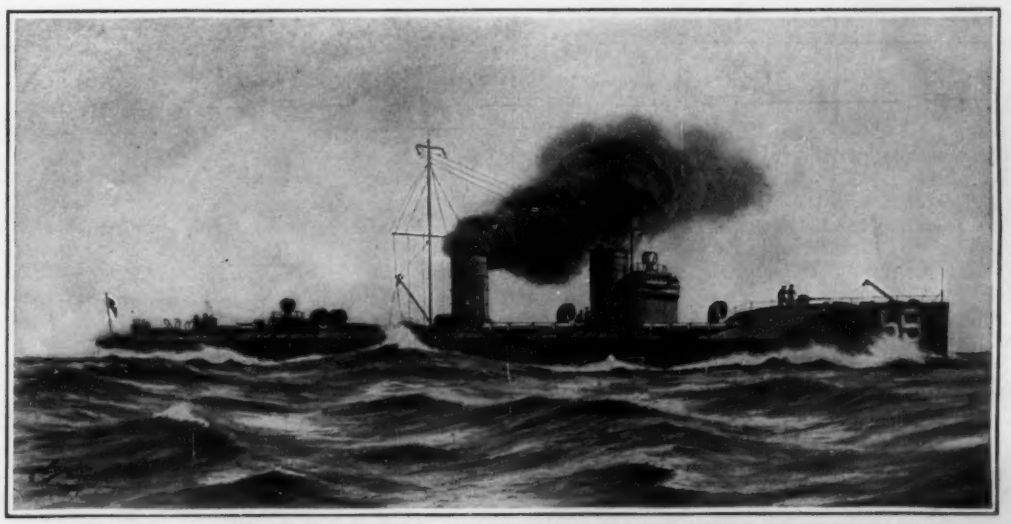
It is interesting to note that while the torpedo boat destroyer was originally constructed as an antidote to the torpedo boat (which at that time threatened to drive the capital ship from the seas) today it finds one of its principal functions in acting as the antidote to the submarine, which also has aspired to end the day of the capital ship.



Displacement: 750 tons. *Horse-power:* 15,000. *Speed:* 31 knots. *Brequet turbines. Date:* 1912.
French "Bisson" Class of Destroyer; a compromise of moderate size



Displacement: 1260 tons. *Horse-power:* 40,000. *Speed:* 36 knots. *Armament:* four 4.1-inch.
Russian Destroyer, "Novik" Class; fast and heavily armed



Displacement: 820 tons. *Horse-power:* 15,000-turbine. *Speed:* 32-35 knots. *Coal:* 200 tons. *Oil:* 70 tons.
German Torpedo Boat Destroyer "S-9;" an "ocean-going torpedo boat"

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Perfect Coöperation of British and American Navies

THOSE of us who have any first-hand knowledge of the British and American Navies have felt assured that there would be perfect harmony between the two services in their coöperative work against the common enemy.

We were well aware that there were differences of organization and routine practice, but, to anyone who had gaged the fine spirit which animates both navies, it was certain that these differences would be readily adjusted, and that they would not strike any jarring note in the joint naval operations.

Unfortunately, an incident of this routine kind which had no significance—a matter referring to a patented device controlled by a British manufacturer—was given a deplorable amount of publicity by the Washington correspondent of a New York paper; and had this statement been allowed to pass unchallenged, it might have left a most unpleasant impression on both sides of the Atlantic.

We are glad to note that Secretary Daniels has lost no time in setting the matter in its true light before the public. As quoted by a Washington correspondent of one of the leading New York evening papers, Mr. Daniels said: "The spirit shown by the Admiralty has been one of perfect openness, frankness and coöperation. Our officers have had access to every bit of information Admiralty officials have had in relation to submarine warfare. They have opened every door to Admiral Sims and his associates." The Secretary states that among the devices made known to our officers were some things of which the American experts had no knowledge at the outbreak of the war, and that, correspondingly, American officers gave freely to the British all the plans they themselves had evolved for anti-submarine warfare.

This statement, coming from the head of the Navy, will serve effectually to nip in the bud this much-to-be-deplored rumor of friction between the Allied navies, and in this connection we quote from a personal letter received by the Editor from one of our officers on the other side, in the course of which he says: "Our relations with the British officers could not be closer. It is all one service and we are knit into their organization as closely as our Pacific Fleet would be knit into the Atlantic Fleet. There has not been a hitch of any kind and I assure you there never will be; for these are our own people, and we are in a home port and they make us feel it. British and American officers work together on boards—one or the other in charge indifferently."

This is all as it should be; and the fruits of this cooperation and the splendid work which our destroyer and patrol fleet is doing on the other side is seen in the steadily diminishing toll which the U-boat is taking of allied and neutral shipping.

Potash—A Recapitulation

IN the last three years the general public has awakened to a realization that potash is a chemical consumed in considerable quantities, and that it is principally in the hands of the enemy. Professor Ostwald, one of Germany's foremost chemists, has been widely quoted as saying that "with her tremendous deposits of potash it is in Germany's power to dictate which of the nations shall have plenty of food and which shall starve." The situation has been acute; but today we are producing increasing quantities of potash at home and in numerous ways of our own. The worthy Professor's forecast looks like an over-confident one.

The metal potassium forms a great variety of industrially important compounds, the most common of which are the sulphate and chloride used in fertilizers, the carbonate useful in glass-making, and the caustic potash necessary in the manufacture of soft soap. Besides these could be mentioned a number of others, as the chlorate which goes into matches, the cyanide used in extracting gold from its ores, and a number of less importance consumed in bleaching, dying, cleaning, weaving and tanning, as well as in medicine and photography.

In one form or another potassium is widely distributed. It is estimated that the earth's crust contains two and one-half per cent of it, and sea water holds five or six hundredths of one per cent—a small amount to be sure, but today a source of American potash. As occurring in the soil it is combined with other mineral substances which slowly disintegrate and yield the life-giving potash in a soluble form readily assimilated by the crops.

The German potash industry started at Stassfurt in 1861, but the present mines are located at several points in the North German plain. The presence of these salt deposits is explained on the assumption that this basin was once a valley, one end of which communicated with the sea over a shallow bar. During a part of the year sea water would be carried over the bar, but in quantities insufficient to replace the loss from evaporation. Owing to a difference in the solubilities of common salt and potassium chloride the potash salts were concentrated at certain points in the lake-bed.

In 1911 large amounts of potassium chloride were found near Mülhausen within twenty-five miles of the French border, and should France recover Alsace she would fall heir to this valuable deposit. Small quantities exist in Galicia, but these have not been developed to any extent, probably due to German influence, since Austria imports large quantities of potash from her neighbor. Promising deposits have lately been located in Spain in the provinces of Barcelona and Lerida. It is said that the German syndicate has attempted, with some success, to buy a controlling interest in these, but the Spanish government has now drafted a law with the idea of forestalling foreign control.

For many years the German producers, both state and private, found it difficult to make money because of overproduction. In order to market the potash profitably a selling syndicate was finally organized to be in effect for five years. All members participated in the total sales on a percentage basis. In 1909 when the agreement expired the members found it impossible to reorganize and for several hours a number of producers sold heavily to America buyers at a reduced price. The German government then stepped in, stopped further trading, and efforts were made to cancel the contracts. A law was passed declaring that every producer was entitled to a certain percentage of the total business, and that if a producer sold more than his fixed percentage he was to pay a heavy supertax.

Of course this applied only to those who had sold to the American buyers, and as the contracts contained a clause that any import or export tax or other governmental charge was to be paid by the buyer, this threw the burden upon the Americans. Our State Department protested vigorously and a tariff war was threatened. The buyers accepted the situation in the end, and some sort of an agreement was reached. A part of the taxes are said to have been refunded as a consideration for the cancellation of the contract.

This affair, showing the point of view which the German government held toward foreign users of German potash, served to awaken our interest in the possibility of finding a domestic source of potash, and the Geological Survey has been very active in this direction. Then came the war, the cutting off of all supplies from Germany, and the potash famine of two years ago, which sent the price to ten times the normal level. That the effort to obtain potash here is well worth making, on grounds of direct profit if not of national necessity, is plainly enough indicated by the fact that our normal imports of potassium salts of all grades have been around a million and a quarter tons annually, valued at some sixteen million dollars. This effort, indeed, has been made, and well made; and we would direct the reader's attention to the very interesting account of the potash situation as it now exists which we carry on another page.

Naval Guns on the German Front

DESPATCHES from the Western front state that there has recently been a great increase in German long-range fire, which has covered the terrain for many miles back of the British front, and that this fire has indicated a sudden and considerable increase in the large-caliber artillery of the Germans. Coming at a time when the German gun factories and ammunition works were being stretched to the limit of their capacity, this increase suggests that the Germans must have been stripping the older battleships and cruisers of their guns, and placing these on howitzer and railway mounts for land service.

A study of the naval lists shows that, without diminishing the strength of the main fighting fleet, it would be possible to secure from the earlier ships several batteries of guns which, although they are out of date measured by modern ordnance requirements, would nevertheless be very serviceable for howitzer and long-range bombardment on the Western front.

Thus, the famous old cruiser, "Kaiserin Augusta," built in 1892, would furnish 12, six-inch, 35-caliber rifles. The five armored cruisers of the "Hertha" class, built 20 years ago, would provide ten, 8.2-inch and six, 5.9-inch, 40-caliber guns. The "Fürst Bismarck" and "Prince Heinrich" of about the same age, both armored cruisers, would furnish six, 9.4-inch and 22, six-inch guns. The "Roon," now 15 years old, another armored cruiser, would provide four, 8.2-inch and 10, 5.9-inch guns.

It might be thought that these armored cruisers are too valuable a type to be thus denuded of their guns, but in view of the swift destruction which befell the British armored cruisers of much greater size and power when they came under the fire of German battleships at the Battle of Jutland, it is safe to reckon these ships as quite obsolete for service in a modern first-line engagement.

Then, we have the 20-year old coast defense vessels of the "Odin" and "Siegfried" classes, quite out of date, which would provide between them 24, 9.4-inch guns, which although they are of but 35 calibers in length would be admirably suited for high-angle-fire attack on vital points far behind the Allied lines.

Also, Germany still possesses two old battleships built over twenty-five years ago, the "Brandenburg" and "Worth," which probably cannot do better than 15 knots today, that would yield between them six, 11-inch guns, 40 calibers in length. These guns, if mounted upon railroad cars, would be capable of covering, at extreme elevation, a zone some fifteen miles or more to the rear of the British and French front lines.

Summing up, the total guns thus made available would represent 12, 11-inch; 70, 9.4-inch; 14, 8.2-inch and 234, 5.9-inch—equivalent to the British and French 6-inch.

This heavy consignment of guns could be sent to the hardly-pressed Flanders front without in any degree reducing the fighting strength of the German High Seas Fleet, which would still consist of 22 dreadnought battleships, five battle-cruisers and nine pre-dreadnoughts of the "Deutschland" and "Braunschweig" classes, together with their necessary complement of fast scouts and destroyers. Now here would be a reinforcement which would serve in a very considerable degree to offset, locally, at least, the superiority in heavy gun fire which has now been obtained by the French and British, particularly on the Ypres sector, where the heavy fighting is now taking place.

It is conceivable also that because of the enormous defensive strength developed by the mine and the submarine, the Germans may have felt that they could spare some of the heavy guns from their less important coast defense positions, and if this has been done it would represent an additional and very powerful supply for the sorely-pressed German armies.

The putting of these old ships out of commission would release nearly fifteen thousand men for manning the German submarine fleet—men who would be already trained to the sea life, and therefore, could be quickly whipped into shape for the special duties peculiar to U-boat service. Perhaps, just here is found the answer to the question which is so frequently asked: "If Germany is building so many U-boats, how does she find it possible effectively to man them?"

The Chemist of the Railroad

ONE would not expect that railroads would have much in common with chemistry, and naturally the general public was surprised to find a number of railroad exhibits at the recent Chemical Exposition. One in particular—a short line running from Elkhorn, Ohio, through the Southern Appalachians to Marion, North Carolina, made a most impressive showing. It had an inspiring story to tell of an enterprising executive who saw a wealth of possibilities in the territory along his line and promptly employed an expert metallurgist and a practical chemist to develop them.

The task was not merely to find raw materials for export to outside manufacturing centers, but to build up an industrial community along the railroad, which would be largely independent of external sources of supply, and which would send out finished products instead. The region is rich in coal and water power, furnishing cheap fuel, steam and electricity. A complete cycle of chemical industries was established. Out of the earth were taken building materials, such as stone, lime, clay and cement; and the forests furnished lumber. Out of the clays were made brick and terra cotta and also fine pottery. Several tannic acid extract plants were established, taking advantage of the cheap fuel and unlimited supply of tan bark. The spent chips of the acid plants were used for the production of cardboard and low-grade paper. A tannery was built to provide a market for local hides, and a factory for the manufacture of shoes to utilize this leather is now under consideration. The coal furnishes coke and by-products which are being developed in the manufacture of dyes. These will be used by the textile mills along the line which get their materials from the cotton fields in the vicinity. Out of the hard woods in the forests, charcoal and wood alcohol and acetate of lime are to be produced.

The story is too long a one to be told here but it may be found in full in the current SUPPLEMENT.

Electricity

A Pilot Lamp for Motormen.—As a labor-saving device, a pilot lamp used in connection with pay-as-you-enter cars is most effective. This pilot lamp is placed in front of the motorman and so arranged that it lights only when the door at the rear is closed, or when the step is raised. Thus the motorman, without removing his eyes from the track ahead, receives a visual signal when to proceed. Meanwhile the conductor does not have to pull a signal rope, but gives all his attention to opening and closing the doors and collecting the fares.

A Telephone Device Which Leaves the Hands Free.—Of the many devices which have from time to time been introduced for improving the telephone or for permitting the user the free use of his hands, one of the latest appears to be in every way ideal. It consists of a sound chamber over which can be placed the usual telephone receiver, and a bifurcated tube ending in ear pieces. So in use the telephone receiver is removed from the hook and placed on the sound chamber, while the ear pieces are placed in the ears; and the user, talking in the normal tone, can carry on a conversation with a party at the other end of the telephone line without holding the receiver or stand. Furthermore, by splitting the sound and distributing it to the two ears, all extraneous noises are shut out and the conversation becomes much clearer.

New Forms of Electric Heaters.—Along with the usual types of electric heaters which make their appearance each year upon the approach of the winter season, there are a number of original types available for the coming cold weather. One of the present offerings is made in the form of a copper bowl or reflector, in the center of which is mounted a spiral heating coil. The bowl is provided with a pedestal which, as in the case of the conventional electric fan, supports it at any angle. Indeed, the new device is strongly suggestive of the electric fan, since its heat can be thrown in any direction by adjusting the bowl. Still another type is made in the form of the common round gas stoves, with a diameter of about seven inches and a height of 21 inches. It provides about six square feet of heating surface, and only weighs 12 pounds. Odd is the remaining type made with the heating surface spread out in one plane. In the smaller size there is three square feet of heating surface. The length of the radiator is 20 inches and the height 16 inches. Its weight is only six pounds.

Every Lamp Socket a Storage-Battery Charging Station.—Operating on the principle of the emission of small particles of negative electricity from an incandescent filament in a bulb filled with inert gas, a recently perfected rectifier is now available to anyone having use for a battery charger operating on alternating current. The new rectifier is made in three sizes: The 6-amp. 75-volt size will charge from three to thirty cells of lead plate battery at from one to six amperes. It is particularly adapted to the needs of public garages and service stations. The 6-amp. 15-volt type will charge from three to six cells at six amperes. It is designed for charging starting and lighting batteries in the private garage. The 2-amp. 7.5-volt outfit will charge three cells at two amperes, six cells at about one ampere, and eight cells at about 0.75 ampere. It is suitable for motorcycle and motor-boat owners or service stations. The manufacturer states that the new rectifier is simple in operation. It is necessary merely to connect the double connecting leads to the battery and insert the attachment plug in any convenient lamp socket. The rectifier is fused against battery reversal and other overloads and includes a compensator which automatically reduces the alternating voltage without using wasteful resistance.

Light for the Phonograph.—Placed in a dark corner or played after dark on the porch, it is often necessary to have light for the phonograph; otherwise there is danger of scratching and ruining an expensive record by failing to place the stylus in the proper starting groove. Of the several types of lights which have been introduced for use in phonograph cabinets is one which attaches to the cabinet of the machine, near the turn table, as distinguished from other types which fasten on the tone arm or sound box. The new lamp is fastened to the cabinet by a very simple method: The pedestal part of the device, which is hollow and contains the switching mechanism controlling the light, is held to the base by a friction fit. Upon removing the pedestal from its base, two special thumb-tacks are pressed through holes in the base plate into the wood beneath. The pedestal is then replaced, and should the rays of light point away from the record after the lamp is turned on, the pedestal can be twisted on its base until the best illumination is secured. Subsequent operation of the light does not destroy this adjustment, as a slight turn of the curved lamp arm closes or opens the circuit. The electrical equipment of the phonograph lamp consists of a 3.8-volt flashlight bulb and a four-volt dry battery. The latter, with proper care, should last approximately one year.

Science

A National Memorial to the Late Capt. F. C. Selous, the well-known British explorer, hunter and naturalist, who aided Mr. Roosevelt in his African expedition, is to be established in England, and may take the form of a scholarship, for the sons of army officers, at Rugby, where Selous was educated.

An Investigation of Drinking Fountains at the University of Minnesota, carried out by the state board of health, led to the rather startling result that the 77 fountains in use at the university, most of which belonged to various supposedly "sanitary" types, were found to be improperly constructed to prevent contamination by the consumer. The principal defect was the vertical discharge of the water, making it necessary for the consumer to place his mouth directly over the point of discharge. In fact, it was found that the majority of persons drank with the lips touching the nozzle. The investigators devised a new type of fountain in which the discharge is at such an angle that there is no possibility of water falling back from the mouth upon or near the orifice.

Number of Eggs Produced by Fish.—Information concerning the number of eggs produced by various species of fish has been limited mainly to rather rough estimates. According to the *Allgemeine Fischerei-Zeitung*, some careful counts were made last year at the Bavarian trout hatchery. The first investigations were in connection with common trout and rainbow trout; 58 specimens of the former and 54 of the latter were stripped, and the ova counted. The older and heavier fish were found to have the most eggs (ranging up to about 3,000), but the younger fish yielded a decidedly larger number of eggs in proportion to the weight of the fish. The experiments were repeated with perch (*Perca fluviatilis*), in this case the females just about to spawn being killed, and the ovaries being removed and dissected. The number of eggs in perch ranged from 3,710 for a fish 4 inches long up to 30,480 for one 10.2 inches long; but in this species, also, the number of eggs per unit weight of fish is much larger in small than in large fish.

The National Physical Laboratory in Wartime.—The war has brought a vast increase of work to the National Physical Laboratory, near London (the approximate British equivalent of our Bureau of Standards). The greatly augmented staff includes more than a hundred women, and it has been busily employed not only in investigating new problems arising from the war, but also in an unprecedented amount of test work for other branches of the government. According to *Nature*, nearly all the gages required for the inspection of munitions are now examined at this laboratory, and the number averages about 10,000 weekly. There has also been a great increase in the number of optical and electrical instruments tested for the Admiralty. A new branch of work is the testing of luminous dials for various instruments. The laboratory continues to be a great center of research in aeronautics, and of course work in this direction has been immensely stimulated by the war. We assume, however, that some of the most interesting investigations recently carried on at this admirable institution will not be made known to the world until after the war. Dr. Glazebrook, the well-known director of the laboratory, was recently knighted; why recently, and not a decade or more ago, is not obvious to his colleagues on this side of the ocean.

Are Schoolrooms Drier than Deserts?—A paper bearing this title was presented at the last meeting of the American Society of Heating and Ventilating Engineers by Mr. George T. Palmer of the New York State Commission on Ventilation. Much has been written of indoor aridity and the tendency has been to answer such a question as Mr. Palmer's in the affirmative. The author finds that schoolroom air may and does contain less moisture during much of the winter season than desert air, and also has a lower relative humidity, but that it does not extract so much moisture from wet objects nor from the human body. In other words while schoolroom air is drier, desert air is more *drying*, which is not the same thing. The apparent contradiction is explained by the more active movement of air and consequent more rapid evaporation outdoors than indoors. The Ventilation Commission has been measuring evaporation in schoolrooms with a Livingston porous-cup atmometer, and the somewhat surprising fact was revealed that in certain rooms where the air is artificially humidified and the average humidity is 38 per cent, there is more evaporation and a greater drying power is exerted on the human body than in other rooms where the air is not humidified and the relative humidity is 28 per cent. The difference in apparent "dryness" is due to the fact that the rooms in the former case are fan-ventilated and in the latter window-ventilated. The important conclusion to which Mr. Palmer's paper leads is that relative humidity by itself is a criterion of neither dryness, nor dryingness, nor the sensation of dryness.

Industrial Efficiency

Increasing Coal Production in France.—Recent figures of coal production in France, an industry of which the Department of the Loire, in the St. Etienne consular district, is an important producing center, with an annual output of over 3,000,000 tons, show an increase from 1,800,000 tons in November, 1916, to 2,367,000 tons in March, 1917, and a total increase in production and importation of from 3,400,000 tons in January, 1917, to over 4,000,000 tons in May. This gain was made possible by a readjustment of mine workers and a closer study of transportation problems, the solving of which has caused an amelioration of the difficulties of this industry. The movement of coal by motor lorries, in addition to other commodities by a fleet of heavy motor trucks purchased and operated by the city of St. Etienne, is a recent inaugurated service which has aided distribution and relief of congestion materially.

A Fortune in Motion-Picture Film Cans.—Owing to the shortage of tin cans through war conditions, the largest producers of motion-picture film stock in the United States have recently notified their customers that the prompt shipment of this raw material cannot be guaranteed in the future. They have also urged all producing plants to return the empty containers they have on hand, for which a liberal price will be paid. How many tin cans are lying about in studios can perhaps be surmised by one typical instance: Following the call of the film manufacturers, one producing organization searched its premises and found 8,142 cans, each with a capacity of 2,000 feet of film. These cans represented the raw stock used at this studio in a little over two years, or a total of 16,284,000 feet. When crated, the cans made twelve truck loads, and it is said that when they were converted into money they represented a small fortune.

Simplifying the Marking of Cases.—In the up-to-date shipping room the marking of cases no longer calls for the artistic talent it used to in the days of the marking brush. Nor does it call for the use of a cumbersome, circular brass stencil containing all the characters required, each of which must be tediously brought into position letter by letter and figure by figure in forming a single line. Instead, anyone can work a stencil machine which cuts the required lettering on a piece of heavy paper. The machine is simple to operate, and any letter or figure can be cut by turning a handwheel until a pointer indicates the desired character, and then depressing a lever. With the stencil once cut, it is laid on the case and a stencil brush applied, marking the side of the case at one operation. It is said that the new method is neater, quicker and cheaper than old-fashioned methods; and this is not difficult to understand, since it is to the shipping room what the typewriter is to the office.

Determining Stenographic Costs.—Nine business houses out of every ten employing five or more stenographers or typists are purchasing this labor at a cost at least 10 per cent above what it should be. A typist's worth cannot be estimated by casual observance. A 10 per cent or even 20 per cent difference in the amount of work turned out in a day's time is difficult to check up under ordinary methods, yet the difference means a 10 to 20 per cent difference in the payroll. In order to give an accurate index of the productive capacity of every stenographer or typist, there has recently been introduced a typewriter cyclometer, which may be readily attached to any typewriter. By taking a reading of the cyclometer in the morning and again at closing time, it is immediately possible to check up the day's work of each stenographer or typist. Many of the largest business houses are using the cyclometer, some of them even going so far as to make up their payroll solely according to cyclometer readings.

A Rapid and Accurate Method of Testing Screws is to be found in the use of a newly-introduced thread-limit gage. This instrument consists of a stand supporting a U-shaped member the arms of which carry two sets of points. The distance between the upper set of points represents the maximum size or allowance for the screws tested, while the lower set is spaced somewhat closer to represent the minimum size or allowance. The contacts are cone-points, hardened and ground to the angle of thread wall. The limits can be set as fine or as coarse as desired, and the range of the gage in this respect is unlimited. To test a screw its screw portion is rested on the upper points while the head portion rests on the fingers of the operator. Thus the force of gravity is used for the test, and the human element is entirely eliminated. If the screw fails to pass between the upper or maximum points, it is too large; and if it passes between the upper points and then through the lower points, it is too small. In either case it should be rejected. The correct sized screw should pass between the upper points and rest on the lower points. To guard against tapering threads, screws can be tested in three places—each end and the middle. It is said that any person, without previous experience, can test screws by this method at a rate of 1,000 per hour.

The Passing of the "Pill-Box"

This and Other German Defensive Schemes Which Have Succumbed to Allied Artillery

"ARTILLERY barrages exceeding in violence anything the world had yet seen, were a feature of this battle," reads part of the correspondent's story of the latest offensive of the Allies on the Western front; and a week later, the same correspondent makes the same statement. In other words, it is apparent that there is no limit to the intensity of artillery fire in this war. And no one knows this better than the Germans, since it has been their lot to face the effects of a steadily-increasing torrent of steel and high explosive.

It was during the battle of the Somme last year that the Germans, placing utmost faith in the invulnerability of their serried lines of sandbagged trenches and deep, concrete dugouts, received their first taste of the power of concentrated artillery. Up until that time they had been facing the rather light guns of the British and French forces, the destructive power of which was seriously limited, even when heavily concentrated. During the battle of Champagne, for instance, in the latter part of 1915, the Germans were heavily bombarded by what was then considered a tremendous concentration of artillery. But the French had few guns larger than six inches, the bulk of their heavy artillery consisting of the 155 mm. piece. Even so, the German trenches were badly shattered, with the result that the Germans decided upon deep, concrete dugouts and heavily cemented trenches which made their appearance very soon thereafter, and which were features of the unsuccessful German defense on the Somme the following year.

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A German "pill-box" machine-gun post, showing the nature of the surrounding terrain following bombardment

Hollow tree used by the Germans as an observation post

But the Allied artillery was by now quite up to the task of smashing concrete dugouts and heavily-reinforced trenches during the Somme campaign. By that time they had learned from the Germans the value of heavy artillery, and were amply supplied with pieces up to and including 15-inch long-range guns, hurling huge shells filled with high explosive. These giant guns, together with the lighter field guns, were grouped in parks so as to concentrate a tremendous fire on a short section of German line. The Teuton trenches were shattered, as we know; and because of their being rather heavily held, the German casualties were exceedingly high. Resorting to deep, concrete dugouts proved of little avail to the Germans; for while it is true that they escaped to some extent the heavy artillery fire, they only survived to be taken prisoners by the Allied infantry who were on top of them before they could emerge from their underground refuges. This was made possible by the moving barrage fire first introduced by the French artillerists.

Aerial supremacy also figured in the old-style trench warfare; for given the control of the air the Allies were able to fly over the German lines and therefore direct their artillery bombardment to a nicety. Reports in the past have told of a row of shells falling in perfect register on a German trench of irregular shape, under the direction of artillery spotters flying overhead.

All of these conditions gave rise to the "pill-box" defense, which made its appearance in the German lines some time this year. The "pill-box" is the British soldier's name for a small, round concrete blockhouse which contains a number of German machine-gunners. The "pill-box" appears to be the smallest of German concrete defenses, some of which are nothing short of fortresses in every sense of the word.

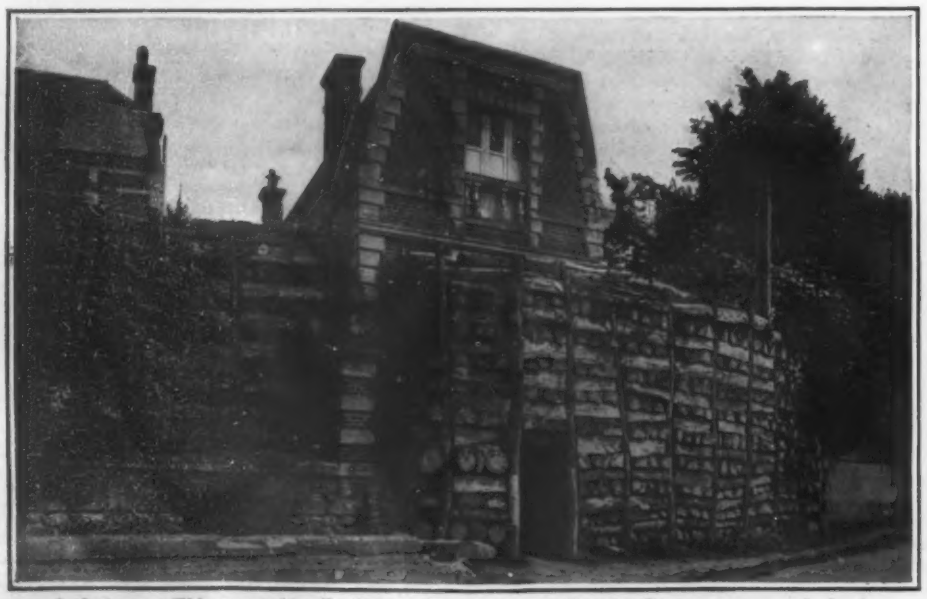
The "pill-box" strategy of this year, if we can interpret the German High Command's scheme by what has been taking place during the French and British offensives of this year, comprises the use of shell holes, trees, rocks, and every other available shelter for machine guns, instead of the old-style rows of trenches. In other words, there is to be no system of positions, but merely a "zone of defense." The organization of this zone of defense is such that the aerial observers of the Allies cannot detect the individual machine-gun posts; hence direct hits by artillery become almost impossible except by mere chance. The troops holding positions in the defense zone are echelonned in depth of feeble density in front, but increasing progressively toward the rear, where special shock regiments and regular infantry are held in force for sudden, smashing counter attacks.

In resisting an offensive the scheme is supposed to work out about as follows: The enemy — either British or French—expends in his customary lavish manner tens of thousands of shells in mussing up the ground in front of him, which in this case is the German zone of defense. By the law of probabilities only a small percentage of German shell-hole positions, "pill-boxes," tree shelters, and so on are put out of action. As the enemy lays his moving curtain of fire or barrage to protect his advancing infantry waves, the German defenders still cling to their shelter; but the moment the barrage is past they take their posts and open fire with hundreds of machine guns on the enemy infantry. The object, it appears, is to kill off or disable as many of the attackers as possible, so that by the time these forces have penetrated the zone of defense to a point where their artillery can no longer support them adequately, and by the time they have been considerably cut down and weakened, the German forces scattered about, reinforced by selected shock corps and regular infantry in the rear, go from the defensive into the offensive with the intention of restoring conditions as they were before the battle.

The success of this scheme, according to captured

(*Concluded on page 296*)

A German shelter of heavy timber and concrete in a forest retaken by French infantry



A chateau at Thiescourt, heavily timbered to act as a shelter for German reserves in back of the "zone of defense"

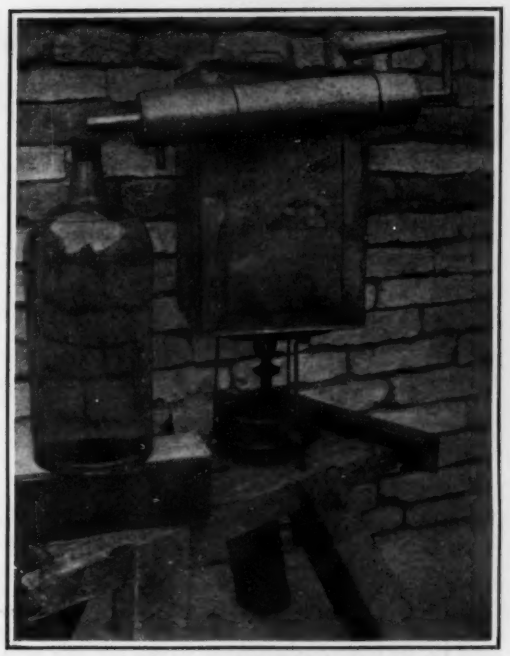
Underground shelters used by German infantry to escape heavy shelling

A Home-Made Still for Field Use

OF the many privations which the soldier is called upon to endure when "On Active Service" none is responsible for greater discomfort than an insufficient supply of pure, drinkable water. This is especially the case in such a country as Mesopotamia, where in spite of terrific heat, troops have marched long distances over arid country and desert wastes with a limited, and in some cases totally inadequate, means of quenching their thirst.

The waters of the Tigris and Euphrates, the two rivers from which this land derives its name, are horribly polluted, the inhabitants living along their banks having converted them into a natural latrine and ablution place. It is, of course, quite true that the harmful bacteria may be rendered innocuous by efficient chlorination, but this, unfortunately, does not remove the numerous impurities which are suspended in the water, even after some attempt has been made to clarify it by sedimentation.

To overcome the difficulty one member of a British Sanitary Section has designed and constructed the still, which we herewith illustrate, and which has given immense satisfaction to those who use it. The materials utilized in making the still were ordinary kerosene tins, a little wire and a disused cartridge case, and as will be seen, the outflow pipe is water-jacketed, thereby increasing the output of the still, which, in a two-hours test, during which the water in the jacket was run off and renewed, turned out three and two-thirds pints of perfectly pure water.



A rough and ready still for drinking water from Mesopotamia

Making Leather Goose Eggs

How the Oval Football Comes into Being

ONCE more we have the football season near at hand, and the country will soon be as wildly enthusiastic over the game as the demands of war will permit. But how many know anything about the make-up of the leather oval that will be watched by countless fascinated eyes on innumerable fields this fall? Even the scribes are at sea regarding its construction, or we should not have the perennial misonomer "pigskin." The leather covers of the cheaper balls are in fact of sheepskin, while for the higher priced spheroids cowskin is imported from England, where it is specially tanned for this purpose. The bladders are made of the best Para rubber. At one time when the game was in its infancy in England, the bladder of a pig was blown up and used as a football, and this is probably how the term originated; but pigskin is entirely unsuited for making the modern football.

Philadelphia is the great center for the manufacture of footballs in the United States. At one establishment in the Quaker City no fewer than forty-two thousand oval footballs are made in a single season, from June to November. About thirty-five hundred round "Association" or "Soccer" footballs are turned out, and some five thousand basket balls.

The regulation football weighs from 13¼ to 15 ounces. Its life depends upon the kind of ground on which it is used in playing the game. The practice among some youths of kicking the football around asphalt paved courts is not calculated to save money for the athletic committee of that particular institution of learning and sport.

The cowhide comes to the factory in big pieces, polished and kneaded and embossed until one involuntarily reaches out in fascination to caress it. These go to the cutting room, where they are trimmed to the necessary shape for making the footballs. The small pieces of leather then go to a room where women work at long tables lining the sections of the future balls. This is important work, and must be done with great care. The girl sits with a huge bowl of paste at one side and the unlined pieces of leather at the other. She turns the leather wrong side out on the table, smears it with paste, and then presses on it a piece of cotton twill, previously shaped to match it. The lining must be fitted and pressed down with precision and neatness; and it may take a girl as much as an hour and a half to paste the linings on a dozen covers.

The covers, still wet from the paste, are next carried to a machine where the linings are sewed fast. That done the lined pieces of leather are passed to another machine which stitches them together in twos to form the football cover in the form in which it will finally be used. But it is wrong side out, so the next move is to turn the covers. The cheaper grade of ball is turned by a machine that pulls the leather out much as a glove is turned. The more expensive balls are turned by hand, a feat which requires a considerable degree of skill and muscular strength, as well as patience. The hands of the men who do this become enormously strong.

The next step in the making of a football is to place the bladder inside and blow it up. Then the ball is stamped on a hot press and "worked" until it is of smooth surface and ready for the field. It is next inspected for defects in material, workmanship, size and weight. The bladder is then taken out from the leather cover, the air let out, and the cover is placed in a box and sealed for shipment and sale.

Lining the leather with cotton twill — Stitching the sections together — Inspecting the finished balls

Three stages in the manufacture of the oval "Rugby" football

Getting Along Without Solid Copper for War-Time Half-Tone Plates

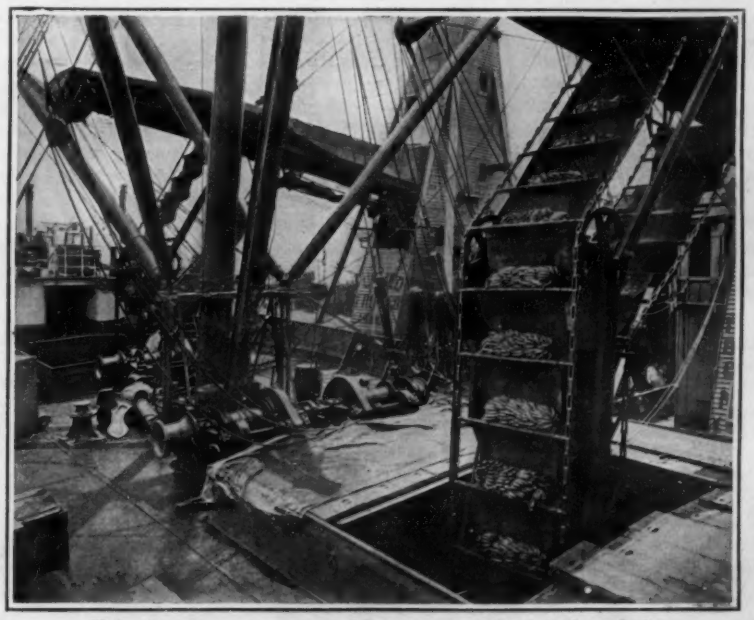
EARLY in the present war the authorities in England ordered that, no matter how much copper an engraving or electrotyping plant had on hand, not any of it was to be used to fill an order for a single half-tone or electrotype plate, we learn from *The Inland Printer*. A number of plates could be made for publications, books or catalogues, but no single plates. This order was modified so that one could get a single half-tone or electrotype, providing he brought in exchange for them an equal weight of copper. Experimenting began in order to find the best plan to make the smallest weight of copper go the farthest in the making of half-tones. For instance, Messrs. Eyre and Spottiswoode deposited a copper shell on a perfectly smooth surface. This shell was tin-foiled and backed up with type metal, as usual, and then shaved to plate thickness, and on such plates half-tones were etched. Further experiments showed that the best plan was to make a thin type-metal base plate. This was brought to almost a mirror polish first and the copper deposited direct upon it. Plates of different thicknesses of copper are made so they can be selected for shallow or deep etching, depending on the fineness of the screen or the character of the paper used. And this method is found entirely practical, according to reports.

An Endless Chain of Pockets

THE conveyor belt is an old story now, but we do not usually think of it as a candidate for the job of carrying anything at all delicate or fragile. So we may look with a good deal of interest upon the photograph shown herewith of a conveyor belt for unloading bananas from the ships in which they come to our shores.

As the picture shows, the apparent unsuitability of this sort of handling for such a destructible commodity as bunches of bananas is evaded by building the belt in the form of an endless chain of large pockets. The whole framework of the belt-carrying mechanism is jointed in several places, so that it can be extended, bent, and dropped through the hatchways into the hold of the vessel, like a giant arm. The belt is then started on its revolutions, and stevedores down in the heart of the ship carefully place a single bunch of bananas in each pocket as it slides past. The pockets themselves are of cloth, as can be seen by a glance at the returning segment of the belt, behind the other and at the extreme right of our cut; and accordingly they are able to sag so as to take a bunch of any size or shape or weight without the slightest danger of crushing the individual bananas or of breaking the bunches.

As a matter of fact, damage to the fruit from the use of this belt is less than that met when unloading is done wholly by hand and foot power. The conveyor leads into a large tower, from which cars or barges may be packed. Our cut shows one conveyor in action and, in the background, another at rest, projecting from its tower.



Unloading bananas on a flexible conveyor belt of cloth pockets

Strategic Moves of the War, October 10th, 1917

By Our Military Expert

THE great battle of the Ypres salient mentioned in the last review—which battle can also be called that of the Ypres-Menin and Ypres-Roulers roads—gave promise of being, as regards results, one of the great battles of the war. No sooner had the gains been made to the east along the ridge that turns at varying heights from Messines and Wytschaete to Zonnebeke and beyond Passchendaele, than desperate counter attacks on the part of the Germans were instituted and continued with unremitting violence. These attacks were apparently made not so much to win back lost ground that might have tactical value as because the Germans now realized to the full the great strategic importance of the British drives.

In this last drive the British commander had removed almost the last protective cover for the Germans between the Flanders lines and the Lille-Menin-Roulers-Thourout-Ostend railway which has formed the principal line of communication and of supplies for the German forces in Flanders. If the higher parts of the ridges could be added to those sections already taken, then this road could be seen—only a few miles away—and could therefore be reached by artillery fire.

With both these objects evidently in view, the past week has seen another of those overwhelming British attacks accompanied by a barrage fire said to be unprecedented and reported to have caused immense loss in columns of German troops that were massed preparatory to a counter attack. The forward rush of the British troops was entirely successful and led to the occupation of several heights due east to Ypres and northeast in the direction of Passchendaele and Grafenstafel.

The victory has been styled by some as the greatest since the battle of the Marne but this is quite an exaggeration and should be received with caution. The British now hold the high ground in the positions mentioned above; but in the northeast there are still high points in German hands; and around the southern end of the ridge near Wytschaete and Messines, no progress has been made for some time. Still, if the results of the victory be measured by losses, then this can be termed a great one for the Germans suffered very seriously in this way.

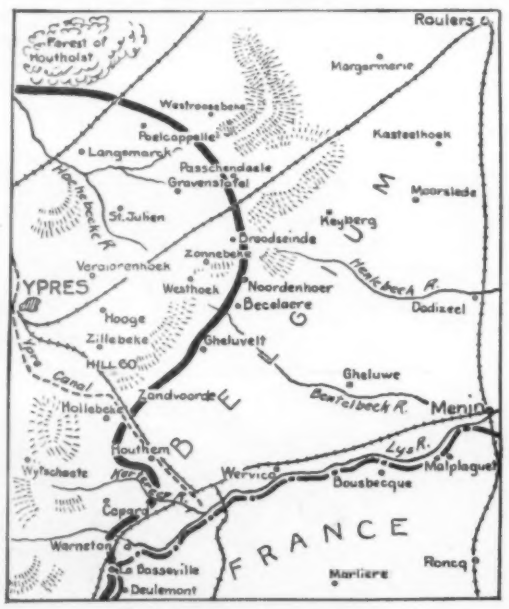
The object of the British Commander in his present assaults appears now quite plain. He desires to recover step by step the Belgian coast and ports. It is therefore necessary to obtain possession of all the high ground on the ridges that have been so hotly contested for three years. It can be said that all the commanding positions east and southeast of Ypres have been taken; but on the northeast much remains to be done. There seems no reason, however, why the whole of the desired high ground cannot be taken in a short time. After that there will lie in front only the flat country of Flanders and an advance here will outflank all positions to the coast and thus render unnecessary any frontal assaults on the positions along the sand Dunes. By cutting the railroad lines running from the coast to Lille all of western Flanders back to Bruges and Ghent must be given up by the Germans. That this withdrawal will be voluntary is very doubtful; but that it will be forced is certain.

The superiority of the B itish over the Germans has again been established in a marked degree. The fighting heart of the German soldiers is giving way despite the dogged determination that has been sh own in so many counter attacks. This fact is now generally admitted by them and has been shown in the most recent tactics adopted. The worst effect on their morale appears to be due to the British artillery fire which has been characterized as too terrible for words. From the farthest rear lines to the fighting front, the troops are subject to a deluge of high explosive shell that levels trenches and earthworks and shatters into bits the concrete "pill-boxes," or small forts that have been recently tried on the fighting lines. The barrage fire is said to be so heavy that an advance can be made only by each single soldier watching a shell burst and then rushing forward with the hope that a second may not burst in the same place. Wounded men have to remain where they lie for they cannot be succored till the fighting lines have passed over and beyond them.

The latest reports from this front state that the British in connection with the French are making another strong drive on the German lines around Langemarck and toward Bixschoote, north of the points where the British had already penetrated for some distance. It will be recalled that during the past summer a large body of French troops took part in the Flanders operations and gained ground from a point north of Langemarck all the way to Dixmude. Since that time, this part of the front has been comparatively quiet while to the south the British were delivering their strong assaults.

It has evidently been thought that it is now time to bring this northern line more up to that of the British front; therefore the French began their advance along the fronts mentioned above while the British continued toward the northeast and took the village of Poelcappelle. The French have been equally successful and are now pushing forward in the direction of Houthulst Forest. These moves continually to the east and northeast confirm what has been so often surmised—that the present great Flanders operations are with the hope and with every prospect of reducing the German submarine bases on the Belgian coast. If, as has been so often stated, shell supply and air control are to be the ruling factors for success, the Allies have everything in their favor under these heads. The latter permits the locating of the enemy's strong points and concentrations while the former gives the means of breaking them up before a hostile advance can be made. The two working together can give a clockwork regularity to every desired offensive by a concentration of men and guns at the exact points desired. The defeats which the Germans have experienced during the present year on this front are the most conclusive indications that the Allies have the upper hand; while a decision has not been forced, it can be said that in no previous struggles here have the Allies shown such energy, concerted action and vigor as are now being displayed on this front.

After a lapse of some months without news of interest



The British drive east of Ypres

word has been received of a severe battle fought on and near the Mushaid ridge on the River Euphrates about sixty miles northwest of Bagdad near Ramadie (Kalact Rannadi). The advance was an evidently well-planned secret movement that hemmed in the Turks from the southeast and west and forced the surrender of the Turkish commander with his staff and several thousands of prisoners. Large numbers of guns and small arms and quantities of ammunition and stores were also taken. The Turkish army that was surprised and captured had evidently been assembled on the Aleppo road near the Euphrates to take in flank the British troops on the Tigris.

This is the first operation on a large scale in this theater of the war since the capture of Bagdad in March last and the subsequent advance of the British forces to the railroad head at Samara, where there is a break in the line until Mosul is reached 85 miles away. Several attempts were made by the Turks to outflank the British but these were in every case defeated and the attacking forces driven off into the hills to the east. No fighting of importance has taken place since, as the intense heat of Mesopotamia in the summer season put an end to any operations of magnitude; but from time to time reference has been made to an advancing column at the Euphrates, which for some distance above Bagdad parallels the Tigris. The defeat and annihilation of the Turkish army on the Euphrates practically clears the way to Mosul as it thoroughly protects and screens the left flank of any column advancing on the Tigris. At any rate it strengthens the British hold on Bagdad, as it has been repeatedly stated that General von Falkenhayn would command the German-Turkish armies that would attempt the recapture of that city.

As regards Mosul itself, the latest reports from Russian sources state that Russians operating from a base at Bitlis are within 50 miles of the town on the north while the British are mentioned as being on the Tigris above Samara to the south of it. These facts show that this, the most important place now held by the Turks, will soon be surrounded by the allied armies. What forces the Turks have been able to assemble at Mosul via the Bagdad railway are not known. But the present outlook is that the Russians will attempt to cut this road by coming along the highway that crosses the Tigris at Djezeret, 40 miles north of Mosul, where the highways west to Aleppo and south to Mosul cross the river. After the defeat and capture of General Townsend and his column at Kut-El-Amara in April, 1916, the Turks believed that the campaign against Bagdad had been abandoned; therefore, every effort was made to complete the Berlin Bagdad railway from Nesibin to Mosul, a distance of 120 miles. Here the road met the Tigris River, but between Mosul and Samara the road has not been finished. The Turkish defeats of the present year have cleared the way and, as soon as climatic conditions will allow, a strong advance of the allies from the north and south will be begun.

From Palestine little has been heard recently but interesting military possibilities here are forecast in news from Mecca contained in Arabic newspapers that have reached this country. This news is to the effect that the Arabs who are in revolt against the Turks in Arabia effected a junction with the British army in southern Palestine. The new Hedjaz kingdom, as a result of the revolt mentioned above, has often been referred to in these reviews. The king, as the new head is styled, has been apparently conducting military operations on a comprehensive and well thought out scale and has joined his cause to that of the Entente Allies who have no doubt greatly assisted him. A considerable portion of the Hedjaz railway running northward from Medina and parallel to the Red Sea coast has fallen under his control, perhaps as far north as Maan; this town is about seventy miles northeast of Akaba at the head of the gulf of the same name on the easterly side of the Sinai peninsula. If this be true, there should be no great difficulty in pushing still farther north and joining the left wing of the British forces at or near Hebron. This is probably just what has occurred, as will no doubt be verified in later despatches.

So far it would seem that Italy is paying more attention to military operations than to moral successes. While it is claimed that Italy in combination with her allies' fleets is planning a continued coast advance and naval attack upon Trieste, it is believed the new move will have a strong effect upon other Allied operations. Austria, knowing what is coming, is doing her best to prepare though it cannot be told at present where the blow is to fall. It is evident that Italy is preparing for a winter campaign that may include Trieste if operations elsewhere are hindered by weather conditions. As one condition now, it may be noted that the battle on the Bainsizza plateau is by no means ended; the first phase is over but the second is rapidly approaching.

After the northwest summit of Monte San Gabriele was taken, two courses were opened to the Italians, either to attack the second peak and then to proceed to the assault upon Monte San Daniele, or to try to outflank these positions and to bring them under Italian cannon fire. It is evident the latter course has been decided upon with the added intent of a move toward the deep gorge of the Chiapovano valley which is the main artery of supply for the Austrians and also the main line of retreat in case of disaster. The work at present is the consolidation of positions on the Bainsizza plateau with the ultimate intent of an advance upon Laibach. Certainly the present outlook fully accounts for the desperate measures taken by the Austrians to check such an advance at all costs; because the only possible meaning of the Italian commander's present moves is a desire to break through the Austrian lines before the winter weather comes.

It appears to have been expected that the successes on the plateau would be all that would be undertaken before winter, thus giving the Austrians time to prepare before spring renders possible military movements. But, if the Italian commander means to cut off Monte San Gabriele, it must be concluded he expects to be in the Chiapovano valley before snow flies there. The Bainsizza plateau offers the best line of resistance to such an advance. Once in the valley, the Italians can turn north and south, inserting a wedge between the two wings of the Austrian armies, thus opening a way to Vienna. The entrance into the valley will be a body thrust for Austria. Knowing this, all the Austrian efforts have been directed to holding all of the plateau possible so as to head off any advance until spring. But it would appear to be the Italian plans to leave San Gabriele and Daniele behind them and to get into the valley as early as practicable, thus destroying at once the Austrian army. Austria has therefore every reason to

(Concluded on page 298)

Potash—What We Are Doing About It

The Many Expedients by Which We Are Contriving to Get Along Without Germany

By Harlow Bradley

WHILE small deposits of potash have been located in Texas and elsewhere, the results have been generally disappointing as far as direct production is concerned. Several of our western salt lakes, however, hold promise. The Searles Lake basin, perhaps the most widely known, was pointed out in 1912 as a source of potash by the Geological Survey. This so-called lake is a dry bed of crystalline salts in southeastern California, some twelve square miles in area and about seventy feet deep. A saturated brine constituting about one-fourth of the total volume fills in the spaces between the crystals, and analyzes about five per cent potassium chloride. It has been difficult to separate the potash from this rather complex mixture of salts, and objections have been raised on account of the borax present. However, a separating plant has been built and a considerable quantity of potash shipped.

There are also several of these alkaline lakes in Oregon, and steps have been taken toward developing them, while the waters of certain small lakes in Nebraska have been evaporated with profit. Although it has been suggested that the salts were leached from wood ashes after great forest fires, it is not definitely known how the potash got into these. The method of getting it out was described in the SCIENTIFIC AMERICAN for February 17th, 1917. Another California plant, at Owen's Lake, has been producing a high grade fertilizer salt as a by-product in the manufacture of soda. The waste waters resulting from extraction of the soda contain a small amount of the other salt. Likewise at Great Salt Lake, Utah, where a number of companies produce common salt by solar evaporation, the bitterns obtained as a by-product are to be worked for potash.

Alunite as a Source of Potash

While we have not yet located in this country any extensive deposits of high grade potash salts, similar to those in Germany, we are fortunate in having large quantities of alunite or alum stone in Utah, Colorado, Washington, etc. This is a chemical combination of potassium sulfate with the sulfate and hydroxide of aluminum. When pure it contains about 21 per cent sulfate, but quartz and other impurities usually reduce this proportion. Heated to a low red heat the stone partially decomposes with the formation of a soluble combination of potassium and aluminum sulfates. A further increase in temperature decomposes the latter also, leaving the potassium salt to be leached out.

The most important alunite fields are located near Marysville, Utah. In one group of claims it is estimated that there are about 475,000 tons of high grade material. During the past two years considerable development has taken place at Marysville. One plant about six miles out consists of crushing machinery to pulverize the material, a revolving kiln in which to heat it, digesters for dissolving the potassium sulfate, and evaporators and other equipment for its final recovery. The product is over 90 per cent pure and sells for about $300 per ton, against $25 to $35 for German potash before the war. It is largely used in fertilizers. Another plant is also in operation here, but is at present merely shipping the decomposed stone in the unleached state for use in compounding prepared fertilizers. However, complete leaching equipment will be installed and crystalline sulfate produced. Other concerns are organizing in the same vicinity and this industry bids fair to become important.

By-product Potash from Cement Kilns and Blast Furnaces

As far back as 1903 it was noted that the soda and potash contained in Portland cement raw materials were volatilized in burning the cement and passed into the air with the kiln dust. A company at Riverside, Cal., set about to catch this dust and has been so successful that with present conditions in potash and cement markets the cement making has become of secondary importance. The difficulty lies in catching the fume and fine dust before it passes up the stack, but this has been met by use of the electro-static precipitator, which operates on the principle of the pith-ball experiment of elementary physics.

Clays and shales suitable for cement manufacture vary in potash content; but the amount present in the raw mixture of limestone and clay, figured as potassium oxide, is roughly 1 per cent, of which somewhat less than half is volatilized under ordinary circumstances. This is largely soluble or capable of being made so. The process is now perfected to a point where 90 per cent of the potash in the raw mix can be volatilized, 80 per cent of this can be caught in the precipitator, and 95 per cent of the potash precipitated can be recovered as high grade sulfate. Six pounds of potassium sulfate are recovered for every barrel of cement produced. A full account of the process appeared in the SCIENTIFIC AMERICAN for October 13th; apparently there is to be considerable development in this field.

A large proportion of the iron ores of this country contain approximately 0.0025 per cent potash, a few running as high as two per cent. The coke used contains another 0.0025 per cent, and the limestone flux four times as much. About twenty-two pounds of the oxide are charged into the Bethlehem, Pa., blast furnaces for every ton of pig iron produced. Some 20 per cent goes into the slag, the rest is dissipated. In fifteen months' experimental operations upon four furnaces, four percent of the total potash charged was recovered in the more easily collectable dust; but even this amounted to over 100 tons of potassium oxide. When our annual pig-iron production of 25,000,000 tons is considered, this source of potash looks attractive. Better cleaning of the gases is itself an incentive, since they are used for fuel and power. Other furnaces have been collecting and marketing their dust of late, and with advances in the technique it is probable that thousands of tons of potash will be thus reclaimed annually

Feldspar and Silicate Rocks

Feldspar often contains 10 to 12 per cent potash combined with silicon and ammonia, although a fair average would be 9 per cent. This can be rendered soluble by heating the mineral with lime and salt or other reagents. It is also proposed to fuse the feldspar with gypsum and

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

German "Gothas" for Attack on the British Fleet

To the Editor of the SCIENTIFIC AMERICAN:

For the last few days the newspapers have been filled with accounts of almost daily raids on London and the vicinity by fleets of large Gotha bombing aeroplanes. It has been generally surmised that these raids were the forerunners of a gigantic and continued series of bombing campaigns on England, which would make up for the decreasing efficiency of the U-boat warfare. This latter has been steadily diminishing during the past few weeks, due apparently to the increasing efficiency of the defensive measures employed, and the general opinion seems to be that the aeroplane raids on England are to be substituted therefor.

In my own opinion, these raids have a deeper and much more dangerous significance. Let us assume that Germany was able to make nightly raids over London with large fleets of aeroplanes. Even under these circumstances, the loss in life and property, while tremendous, would in no wise affect the vigorous prosecution of the war, and the ultimate defeat of Germany.

On land, Germany is fighting a defensive and increasingly disastrous campaign. On the sea her U-boat campaign is dwindling to the point of insignificance; her food supply is largely cut off, due to the newly enforced embargo on exports to neutrals by the United States; and next spring she has to face the tremendous drive of the Allied armies backed up by the new American army—and all this with her reserve of men near to the breaking point.

What is left for Germany? Obviously, the only means by which she can hope to emerge victorious from the war is by a gigantic stroke which will give her command of the seas. This cannot be done by the U-boats alone, and no one realizes this more keenly than Germany herself.

In the battle of Jutland, with all the atmospheric conditions in her favor, she was lucky to escape from the British fleet with approximate equal losses on both sides, and has not tried a gefferal engagement since. Obviously to engage the British grand fleet with any chance of victory, she must employ some new and terrible weapon.

With this in mind, a brief dispatch in the newspapers some months ago, assumes new and alarming significance. It was to the effect that a British merchant vessel had been sunk by a torpedo launched from a German seaplane. It is extremely significant that this mode of attack has never been repeated, either successfully or unsuccessfully. What is the reason for this? Obviously, that the Germans are resolved not to repeat their previous mistakes in tactics, when they launched both their U-boat campaign against merchantmen and their gas attack against the British army without sufficient preparations and munitions to take full advantage thereof. By the time that both these campaigns had been fully developed the Allies had evolved an efficient defense therefor, and consequently the full fruits of the surprise were lost.

Another fact tending to confirm this view is the report published some time previously, of a light and speedy German cruiser especially fitted for producing dense smoke clouds. It was announced from neutral sources that trials were being held on such a craft, but nothing since has been heard of it.

Is it not conceivable, therefore, that the air raids on England by these large German bombing planes are simply a means to an end: namely, to perfect the German aviators in the handling and navigation of large fleets of these heavy machines? They could readily be fitted for carrying a torpedo instead of a cargo of bombs, and would then form a most efficient means of attack during a naval engagement.

Of course, it would be impossible by such means to attack the British fleet at its base, for that base is far removed from the German aeroplane bases, and the British fleet is normally protected by a defense of booms and nets which no torpedo could penetrate, but in a naval engagement near the coasts of Germany, with the British fleet under way, neither of these defenses would be available.

Let us assume that a battle between the main fleets of England and Germany was in progress. The two fleets would approach each other and firing would begin at extreme ranges. Suddenly a fleet of fast German cruisers and destroyers would dash between the two fleets, spreading a cloud of thick, oily smoke, which would thus form a barrier through which nothing could be seen. If the Germans were to windward, a position which they would seek previous to the opening of the engagement, this smoke cloud would roll down toward the British fleet, and the vessels producing it would be thereby screened from accurate fire. When this cloud was within a thousand yards of the British fleet, a swarm of huge German seaplanes, each carrying a torpedo, would suddenly appear through it, close to the surface of the water. Each plane would head directly toward a British dreadnought and drop its torpedo, which would thereupon be started upon its path of destruction.

It is quite conceivable, that, unless adequate measures of protection are taken before a general engagement occurs the British fleet at one blow would be so crippled as to allow the Germans to meet it on equal, of not superior, terms.

Apparently the only method of defense possible against this mode of attack would be other seaplanes, armed with machine guns or light quick firers. On account of the great weight of even a small torpedo, the German seaplanes would be rather slow and unwieldy. Furthermore, they would have to fly at a low altitude in order to discharge their torpedo. Under these circumstances they would be easy prey for an efficient fighting seaplane, but unless these are supplied in large numbers as an adjunct to the British grand fleet, the world may some morning read that the control of the seas has passed into the hands of the Germans—with what results it would be hard to contemplate.

PHILIP W. ALLISON.

New York City.

Anti-Submarine Strategy

To the Editor of the SCIENTIFIC AMERICAN:

The following are some ideas suggested by reading your submarine articles.

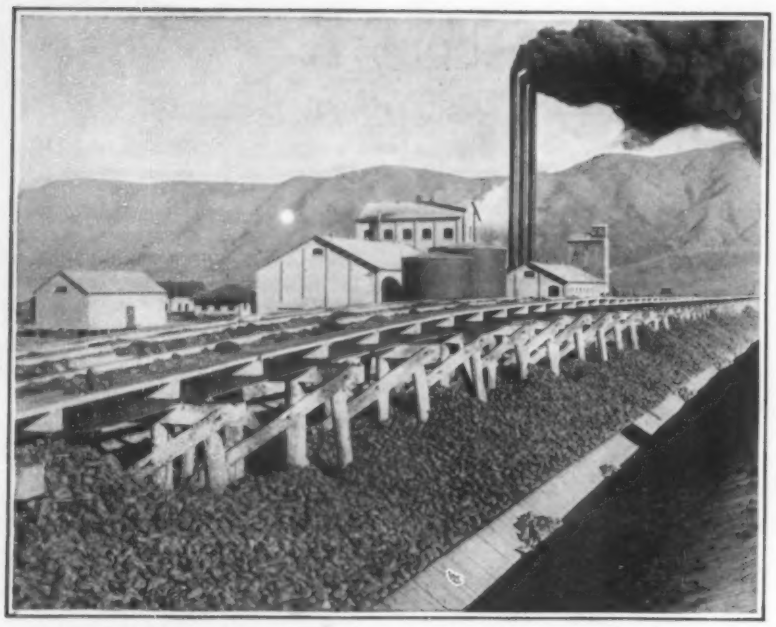
A merchantman poorly gunned might with advantage shoot shells containing smoke screen material between sub and itself.

Poisonous gas and tear-making gas shells might be shot in front of subs. This would drive sub gunners below and perhaps fill sub itself with gas. This requires no great accuracy of fire.

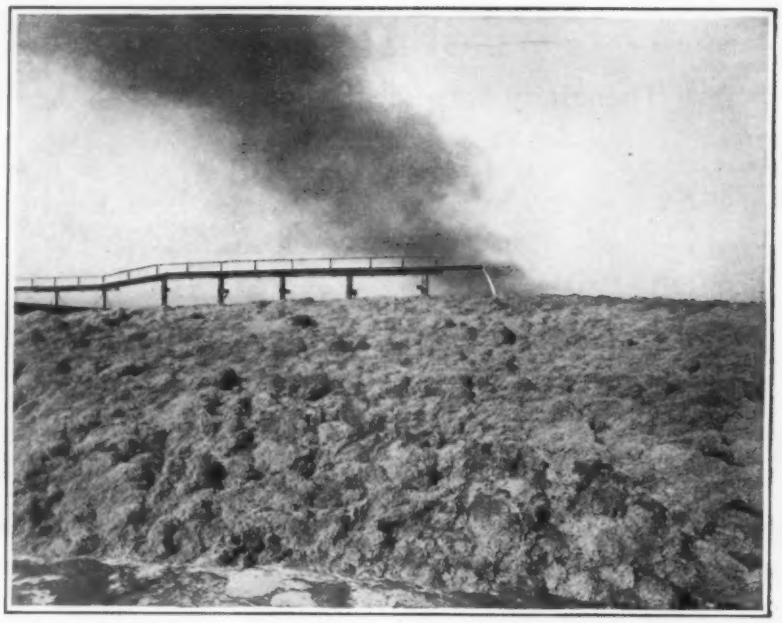
Disguise sub destroyers or other well protected vessels as helpless merchantmen, and give poorly protected vessels the appearance of being well protected say by putting wooden guns on board, etc. This will cause sub to attack destroyers and well protected vessels and eventually make them hesitate in attacking any vessel.

WILLIAM CROCKER.

Prescott, Ariz.



Beets in storage waiting their turn to be worked up into sugar



How the beet pulp looks after giving up its sugar and being reduced to fodder

Filling the Sugar Bowl

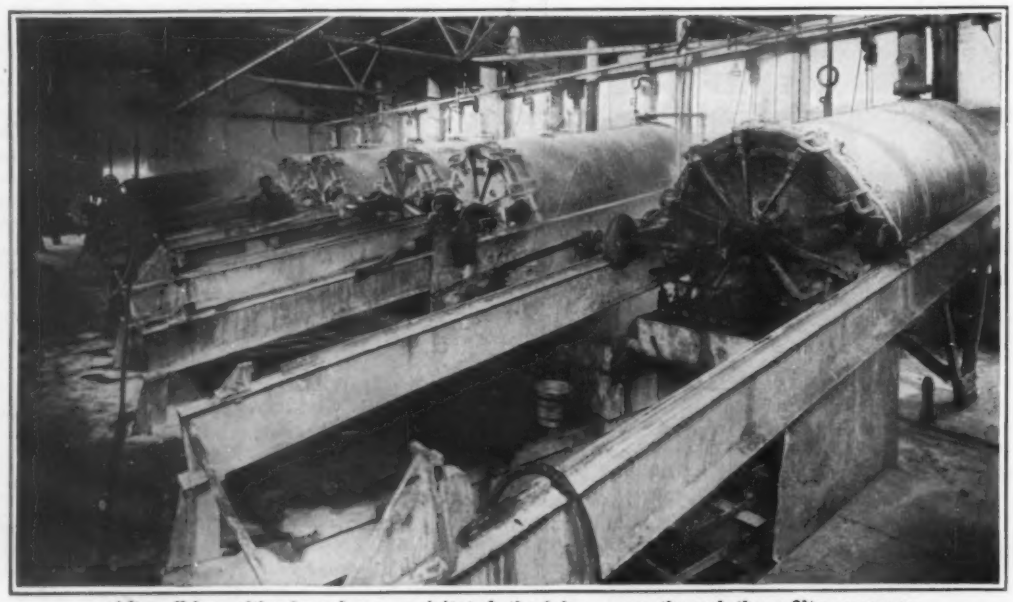
The Contribution of the Lowly Beet to the Breakfast Table

By Ernest Elva Weir

SUGAR is sugar whether made from Cuban cane, Canadian sap, or beets, just as eggs are eggs whether laid by a Rhode Island Red or a White Wyandotte. The analysis of cane and beet sugar is precisely the same when pure—12 parts carbon, 22 parts hydrogen and 11 parts oxygen; and, as Dr. Wiley says, chemists cannot distinguish one from the other.

Less than a century ago, it was discovered that a certain family of wild beet contained sugar to a degree that made it valuable as stock feed. Experiments showed that, by a careful selection of the mother beets used to produce the seeds, both tonnage yield and sugar content could be increased. This led to repeated attempts to extract the sugar from the beet in such a state of purity as to make it valuable for human consumption. It was deemed an achievement when a ton of sugar beets was made to produce 120 pounds of refined sugar. But with the aid of better methods of cultivation and improved processes of extraction, it is a poor crop of beets nowadays that will not yield from 240 to 250 pounds of refined sugar to the ton. The manufacture of sugar from beets is a process that has been brought to the highest state of perfection, and to follow the beet from the field to the table makes a story as fascinating as a fairy tale.

Sugar beets are usually white. Only the roots are available for manufacturing purposes, the tops being left on the ground. The roots are delivered to the factory by wagon or cars on elevated tracks or runways and dumped into storage sheds. As required, the beets are floated by water from the sheds into a specially constructed revolving wheel which allows the water to drain off through a perforated rim. The wheel raises the beets and delivers them into a washing machine, a large horizontal cage in which revolves a shaft carrying arms set in a spiral form; the cage is submerged in water. In revolving, the arms not only stir the roots and cause them to rub against each other, but also force them forward from the receiving to the farther end of the cage.

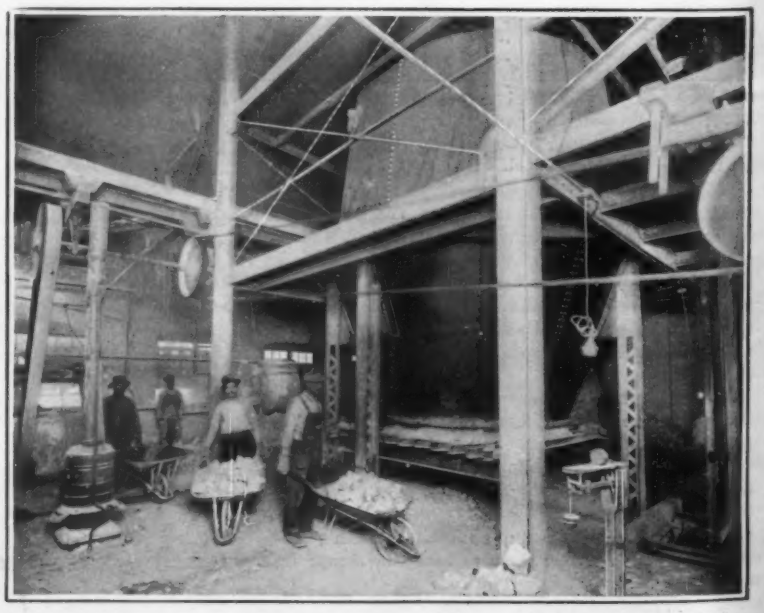


After all impurities have been precipitated, the juice passes through these filter presses

This process cleanses the beets of all adhering earth, sand, etc. A continuous bucket then lifts them to the top of the factory into an automatic weighing scale and afterwards drops them into the slicing machine. Here the beets are cut into small strips about the size and shape of shoe-string potatoes—called "cossettes" or "chips"—and are thrown into an inclined chute or travelling belt conveyor. This carries them to the diffusion battery, one of the most interesting of the many devices used in the manufacture of sugar.

The diffusion battery has been found to be the most efficient method of extracting sugar from beets. It consists of a series of diffusing

The circular battery of diffusion tanks in which the beet gives up its sugar



The lime kiln where the sugary extract is purified from foreign matter in solution

pans arranged either in a circle or a straight line. As a rule, a battery contains 10 or 12 diffusing pans numbered consecutively; these pans are heated by steam. On the first day of the campaign, each pan receives its supply of chips. Number One is at the head of the battery and Number Ten or Twelve brings up the rear. Water is poured into Number One, whereby part of the sugar contained in the pieces of beetroot is dissolved. By means of an ingenious system of valves, the water flows to Number Two. It extracts part of the sugar contained in the chips in that pan and flows on to Number Three, and so on through the entire series. Its percentage of sugar thus increases little by little at the expense of the chips in the successive pans.

As the water suply is kept continually flowing, the sugar content of the beets in the various pans is exhausted in rotation, the pieces in Number One of course being the first to be reduced to a sugarless mass. After the exhausted pulp has been discharged from the first division of the battery, this pan is again filled with fresh pieces of beetroot and now becomes the last of the series, while Number Two takes the lead. Each diffusing pan, therefore, is the last and the first in turn, the first when the pieces of beetroot are nearly exhausted, the last when they have received a fresh supply. The circular arrangement, of course, lends more facility to this shift than does any other. The diffusion process is so efficient that it extracts about 97 per cent of the total sugar in the beets.

Having served their purpose, the exhausted chips are pumped or flumed to the "pulp silo" for use as feed for sheep and cattle.

The juice of the beetroot as it leaves the diffusion battery is a turbid liquid of a deep purple or violet color, with a peculiar taste and odor. It contains impurities in solids and in solution. The solids can be removed by filtering, but those in solution must first be rendered insoluble by a process known as double carbonatation.

From the battery, therefore, the juice passes to "carbonatation tanks" where milk of lime and carbon dioxide gas are added while the liquid is being agitated and heated. Under these conditions, the lime combines with the impurities and forms a precipitate, which is filtered off. The clear, partly purified juice now enters a second carbonatation tank where it receives a treatment very similar to that in the first. Carbon dioxide gas is formed by the burning of limestone and coke in a lime kiln, usually located in a building separated from the main factory. Before being pumped into the carbonatation tanks, the gas is thoroughly washed with fresh water in a specially designed washer.

From the second carbonatation tank, the juice is pumped to what are known as sulfitation tanks. Here the liquid is bleached with sulfur dioxide gas. It is again filtered, enters the multiple vacuum evaporator and is thickened by the evaporation of some of the water. The thickened juice is again treated with sulfur dioxide gas and filtered. Comparatively speaking, beetroot contains large quantities of mineral substances or ash in solution. These are not all removed in the carbonatation tanks, but are thrown out of solution in the evaporation process for the very simple reason that enough water is no longer present to dissolve them. Before proceeding with the final process of concentration, a further filtration is necessary, after which the clear syrup is passed to the vacuum pan.

Here the liquid is boiled until the small sugar crystals are ready to appear, when the graining is encouraged and the crystals carefully nursed by the gradual addition of more syrup, so that they develop while the mass is

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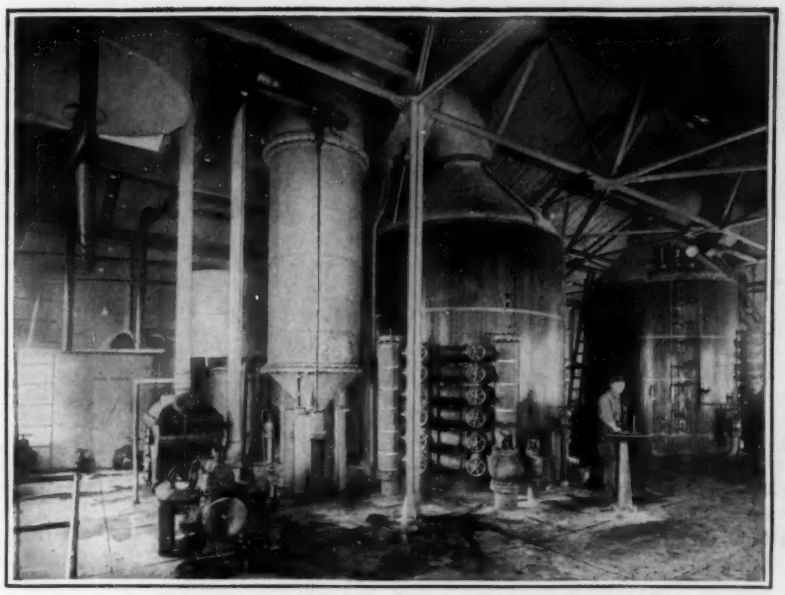
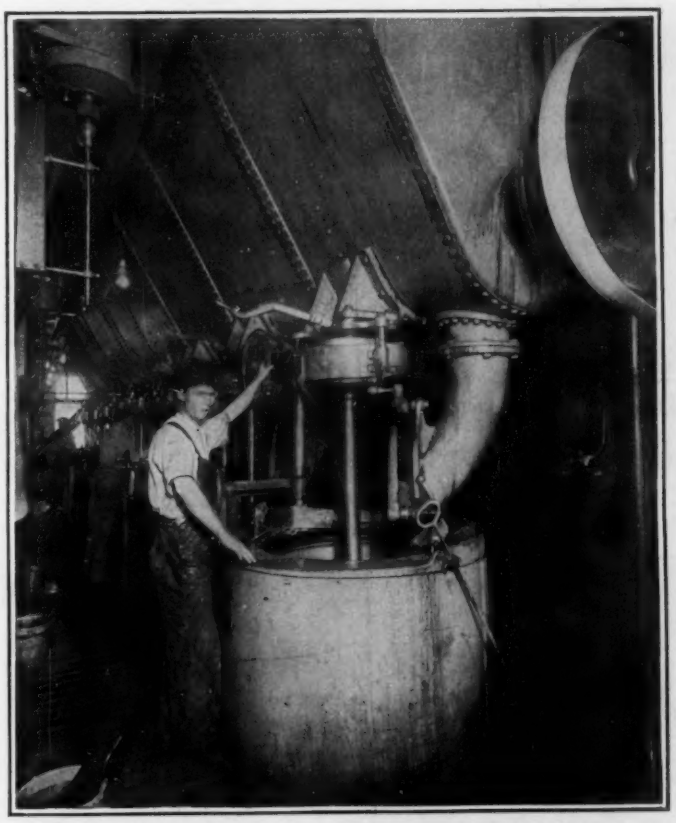


The vacuum pan. Here the purified juice is boiled until it begins to grain



The centrifugal machine that separates the sugar crystals from the still uncrystalized syrup

The last stage. A giant conveyor loads the sacks into piles reaching to the stockroom roof

The Guns Behind the Bonds

By Walter Scott Meriwether

WHAT will the government do with the vast sum which is being raised by the Second Liberty Loan? It is easy to speak of millions for the army, millions for aviation, or millions for the navy. But what are the details of the stupendous total?

Here are some figures which outline the cost of a relatively small but immensely important item of the huge war budget—the great guns which form the main battery of our later dreadnoughts.

The gun upon which the Navy places its chief reliance is the 14-inch rifle, a weapon whose 1,400-pound armor-piercing shell has cut through 16.7 inches of Krupp steel a a range of nine miles. The powder used in this huge piece is of the so-called smokeless kind. It is not really smokeless for every time one of these guns is fired a full acre of dense black smoke boils around the ship. But instead of hanging about the vessel in an obscuring cloud, it vanishes like steam on a frosty morning.

The guns are 45 calibers in length; that is, their length is 45 times the diameter of the bore. Although the explosion is apparently instantaneous, the powder burns with pr gressive force and increasing energy as it propels the shell through the bore and gives to the missile an initial velocity of 2,600 feet a econd and a muzzle energy of 65,687 foot-tons, which translated into every day English means that the force exerted at the muzzle is sufficient to lift 65,687 tons one foot in air.

The weight of this gun is 63 tons; it cost upwards of $80,000 and requires six months to construct. And yet the gas life of this costly piece is only seven seconds. By this is meant that it can withstand the strain of battle charges for only that short period of time. Each time the gun is fired with a full battle charge, it is subjected to the strain of the explosion for one-tenth of a second, and after the seventieth round, it has been found that the erosion of this strain makes it necessary to remove the gun from its turret and send it to the machine shops for relining.

The navy target practice, of which we used to hear so much and now hear nothing at all, was chiefly with reduced charges and cast iron shell, experimental firing which did not impair the efficiency of the gun. At certain periods there was record practice at long ranges, but in these only a few shots were fired from each gun. That was because of the great cost of the gun itself as well as of its shell and full powder charge; for when one of the newer dreadnoughts goes out for battle practice, every time a gun pointer touches his electric button it costs the government fully $1,000.

That may appear like an enormous waste, but in reality it is money well spent. For in the final analysis the chief business of a navy is not only to shoot, but to shoot straight. You cannot make a navy marksman without practice, any more than you can make a billard expert without practice.

All of our earlier dre d-noughts were armed with 12-inch rifles, but the later output have the 14-inch type. Six of this class mount this formidable weapon, these being the "New York", "Texas", "Oklahoma", "Nevada", "Pennsylvania", and "Arizona". The five now nearing completion will have the same type of gun, these being the "New Mexico", "California", "Tennessee", "Mississippi" and "Idaho".

This involves a total of 124 guns of 14-inch caliber, built at an aggregate cost of $10,000,000. This cost does not include the carriages, which weigh almost as much and whose recoil gear must take up a shock equal to that of 20 Pullman coaches running at 70 miles an hour and brought to an instant stop.

Protecting Wood From Decay and Fire

An Effort to Reduce the Annual Destruction of Nine Billion Board-Feet of Wood

By Clyde H. Teesdale, Forest Products Laboratory, Madison, Wisconsin

ALTHOUGH wood has certain natural advantages over other building materials, the substitution of other materials for wood has gone ahead very rapidly, due partly to the demand for permanent and fireproof construction. Wood in exposed situations is subject to decay and in congested districts is an added fire hazard. It is estimated that about nine billion board feet of wood in the form of ties, poles, mine timbers, piling, lumber and shingles are destroyed annually by fire, insects, marine borers, mechanical wear and decay. Decay causes about 80 per cent of the destruction. Proper protection will prevent much of this loss and is most important where wood, except for the danger of fire or decay, is best suited to the purpose. For example, no satisfactory substitute has been found for the wooden railroad tie, but wood preservation has made it possible greatly to increase the life of a tie. The Forest Products Laboratory at Madison has been very active in the study of wood-destroying agencies, various preservatives and methods of treatment, and in bringing to the attention of wood users the advantages of preservative treatment.

Tests have been made by the Laboratory in coöperation with railway, telephone and mining companies and with various cities and universities to determine the life of natural and treated wood, which have shown that the life of wood used in exposed situations, or in contact with the soil or water, can be increased at least three fold. Results of such tests have been published from time to time and indicate the saving which can be made in both material and money due to preservative treatment. Furthermore, such information is necessary before new preservative and processes are adopted by engineers. In one instance the installation of a small treating plant by a coal company reduced their annual consumption of timber to one-half of the amount previously required, though only part of the timber used was treated. The Forest Service has designed some 12 wood-preserving plants for wood-using companies and assisted in the design and preliminary operations of many others. A large amount of information on the best methods of treating certain woods, of operating various types of plants, and of handling certain preservatives is being constantly supplied in reply to inquiries.

Many woods of comparatively little value, such as loblolly pine of the Southeast, jack pine of the Northeast, and lodgepole pine of the Rocky Mountain States, have been shown to take treatment easily and to be suitable for ties. The use of these pines for tie purposes doubled between the years 1909 and 1914. Statistics show that the number of ties of the more durable species, as heart yellow pine, white oak, etc., has decreased while purchases of non-durable species, as sap pine, gum, maple, etc., have increased rapidly. A plant has also been constructed in the South for treating loblolly pine for poles, and sales have been made of various species of pine from the National Forests, previously considered of little value for poles.

The methods of treating poles by the brush and open-tank process adopted by the National Electric Light Association are based on the recommendations of the Forest Service. Similar methods have been adopted by the American Telephone and Telegraph Company, and most of their replacement and new construction poles are being treated. Numerous independent companies are also treating poles, and the data compiled from experimental pole lines of the Forest Service are being used as the basis for recommending such treatment.

Perhaps 50 perservatives, including creosotes and salt solutions, have been studied to determine their effectiveness in checking the growth of fungus, their ability to penetrate wood, their effect on the strength of wood, and their permanency. In the case of creosote, the preservative represents about 75 per cent of the cost of treating. The tests have shown the necessity for careful analysis and grading of the creosotes used as wood preservatives, and laboratories have been established by the largest water-gas-tar company in the United States and by one of the largest creosote companies for the better handling of their wood preservatives. The work of the Forest Service in analyzing and grading preservatives has been used by the American Wood Preservers' Association and by the National Electric Light Association in formulating specifications for wood preservatives.

In 1915 there were over 4,000,000 square yards of creosoted wood block in use in the United States, sufficient to pave 800 miles of city streets. The chief difficulties in using treated wood block for street paving have been bleeding, or the oozing of oil from the blocks, and swelling. These troubles have apparently been overcome by changes in methods of treatment and of construction which are now being tried out by several cities. Several species, such as tamarack, Norway pine, white birch and hemlock, formerly little used, were shown to be suitable for paving block. Wood block is growing in favor as a flooring for warehouses, machine shops, and even menageries, as the methods of handling it are improved.

A dummy office ready for a fire test of treated furniture and walls

After the fire. The treated wood was "partly carbonized but did not support combustion"

One of the most difficult problems to be met in wood preservation is protection of piling in salt water from marine borers. Untreated piling is sometimes destroyed by these borers in 30 days, while there are records of 10 to 30 years' service for treated piling. The experiments with pile protections are now being made in coöperation with the Bureau of Fisheries, which is studying the life of the borers and how it is affected by various preservatives, while the Forest Products Laboratory is keeping records on service tests of specimens set on the Gulf and Pacific coasts. The test specimens have now been in service seven years. The results are showing how specifications should be drafted to obtain longer service.

A fire-test house was built by the Laboratory to approximate conditions in the average office. The house is of concrete and is heated from an oil furnace adjoining it. In a test using untreated flooring, trim, and furniture combustion took place after reaching about 900° F. and the temperature then went up to about 1700° F. The contents were totally destroyed. The room was then refinished and refurnished with treated material and heated exactly as before. The contents were partly carbonized but did not support combustion, and the temperature would not go much above 900° F. Although the contents of the room were ruined in the second test, the fact that there were no flames and that the temperature was not raised by combustion are very significant. The treatment used was a mixture of ammonium phosphate and ammonium sulphate.

The importance to the architect and engineer of a thorough knowledge of wood preservation is illustrated by the experience of the New England cotton manufacturers. About 1898, the mill owners began the construction of one-story buildings instead of five or six-story buildings as previously. Their object was to improve lighting conditions. A humidity of about 70 per cent is maintained in the weave sheds and in the winter the roofs of these buildings are at a lower temperature than the air within so that moisture condenses upon the roof planks and decay sets in. In the old buildings the weaving is done on the first and second floors and with other floors above little trouble is experienced, so that mills constructed in 1790 are still in use. Some of the new buildings have steel frame roofs and wood plank, and a few have recently been constructed of concrete, but wood is preferable to concrete. Hence measures for preventing decay are important. The ordinary treatment given ties and structural timbers will not answer, because it might damage the goods in case water dropped on them from the treated roof. It is also desirable to paint the roofs white to improve the light and appearance. Sodium fluoride has been suggested as answering the requirements and tests will be made in some of the mills to try various remedies.

The Laboratory is endeavoring also to encourage proper sanitation in lumber yards, as a precaution against the use of material already infected in mill construction. The "house fungus" of Europe has been found widely distributed in lumber yards in the eastern United States, and since the same fungus occurs frequently in buildings over the same range, it is probable that in some instances infections have been introduced in diseased stock. Field studies have shown carelessness in many of our lumber yards as regards the sanitary handling of timber. The majority of dealers do not realize the full danger in supplying infected stock to the building trades, and take very few precautions to maintain their stock in sound condition.

Potato-Drying in Germany

SHORTLY before the war much was published in American journals about the rapid growth of the potato-drying industry in Germany and the various ingenious methods by which the large surplus of potatoes produced in that country was being converted into meal, flakes, etc. The number of factories engaged in such work increased from three in 1903 to 488 in 1914. From an article published at Königsberg last September it appears that the German government was prompt to recognize the importance of these establishments in time of war and has been helping start new ones by granting subsidies. By July, 1916, the number of factories had increased to 841. With work going continuously night and day for 200 days in the year, all the factories in the empire are able to produce 12,000,000 tons of dried potatoes from 30,000,000 tons of raw material. Marked improvement is reported in the methods of drying. Cylinders (*Walzenapparate*) and drums (*Trommelapparate*) are now generally used. The former can deal with 1.2 to 1.5 tons of potatoes an hour, and the latter with as much as five tons. The dried product is easy to transport and keeps indefinitely. As a rule flakes and cubes are used for feeding cattle and various potato flours for human consumption.

Mice by the Millions

NOTWITHSTANDING her disastrous experience with rabbits, Australia has again exposed herself to the consequences of upsetting the balance of wild life. As a result of ill-advised compulsory poisoning laws, the carrion hawks, crows, and native carnivora have been nearly wiped out. This has at once increased the number of animal corpses and greatly decreased the ordinary agents for their disposal; and as a result decaying bodies are left to be demolished by blow-flies. These have accordingly increased to such an extent as seriously to threaten the destruction of the sheep, who become fly-blown and infested with the larvæ of this dangerous insect.

In addition to this first effect of her biological misdeeds, the colony is now discovering her misfortune to be a double-barreled one. The "pests" so ruthlessly destroyed were not an unmitigated nuisance, it appears; they must have been the means of keeping the rodent population down to reasonable proportions. In the absence of the old enemy, and in the presence of one of the greatest wheat harvests in Australia's history, which must be largely stored because of lack of shipping, the mice have increased so fast that the usual term "multiplication" fails utterly to portray the situation. The mice are everywhere, by the millions; and as one correspondent

(*Concluded on page 296*)

A Strange Fatality

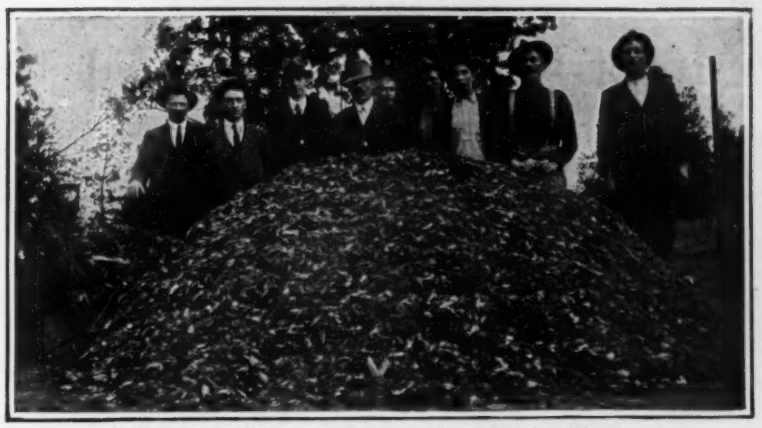
WE illustrate a strange tragedy of the air which occurred during the annual bird migrations. The victim, one of a flock flying low on a thick, foggy night, struck head on against the side of a barn with such force as to crack the board cleanly and bury his bill to a considerable depth in the wood. Whether his neck was broken by the impact we are not informed; but in any event it would be easily understandable that, from the state of rest imposed upon him by his unfortunate position, he might well be unable to apply sufficient power to remove his beak from the crack in which it had been so tightly wedged by a force equal roughly to the product of his weight and the velocity of his flight. In any event, when he was found and photographed in the morning he was frozen solid in the position shown.

A Landmark of Primitive Engineering Gone

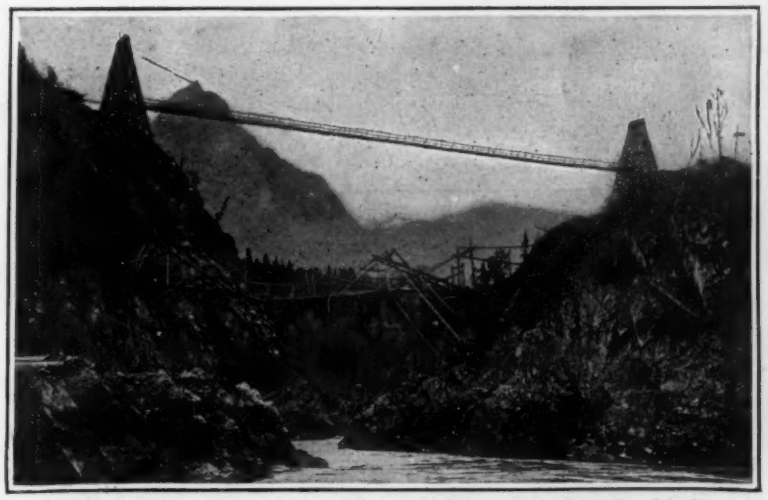
MANY years ago, when ocean cables were an object of experiment only, and discouraging experiment at that, the project was launched of connecting the old world and the new by means of a telegraph line through Canada and Siberia, and across Behring Strait. The undertaking had progressed to the point where supplies of telegraph wire had been transported to various points in the wilderness en route, when the first cable was successfully laid and placed in operation. Naturally this caused a break in the market for stock of the 20,000-mile telegraph line, and the company promptly blew up, leaving its precious bundles of wire where they lay.

In at least one instance the natives put the material in question to a useful end before the elements had taken in hand the work of destruction. The Hagwilget Indians of British Columbia, inhabiting the region through which the Buckley River flows in a deep canon, had long been inconvenienced by their inability to bridge the ravine. Upon finding the coils of wire they saw a way out. Without any engineering experience, knowing nothing of the laws of suspension bridges, of stress, vibration or tensile strength, possessed of no tools worthy the name, the Indians yet succeeded in throwing across the river a bridge 146 feet long and 10 feet wide, consisting of a timber flooring supported by wires. In the whole structure there was not a single nail, the joints being made by dovetailing and burning a hole through the logs with red hot coals, followed by the insertion of a wooden spike.

For several decades this unique bridge, which swayed and rocked like a ship in a stormy sea, was used by whites as well as natives. Over it passed a goodly part of the great Klondike rush. But finally it was paralleled by a regular suspension bridge, and consequently thrown out of use. Several efforts were made to get an appropriation for its preservation as a curiosity, but without success. Accordingly it has deteriorated rapidly of late years, until finally this fall it collapsed and went down the river. The picture which we present, showing the new and the old bridges side by side, is perhaps the last view taken of the historic old structure.



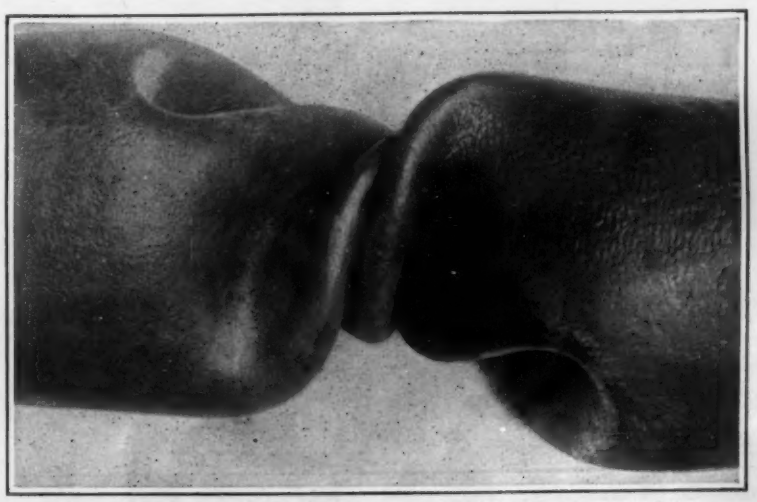
Eight tons of mice—representing four nights' catch at "a point in Australia"



The telegraph-wire suspension bridge which has just collapsed, with the new structure looming up behind

One peril which the "high flyer" escapes

Raising oneself by one's bootstraps



One of the tests that first class pipe must stand before the up-to-date purchasing agent is convinced

A Pulley Puzzle

CAN the body exerting the force on the chain around a loose pulley also be, at the same time, the body which is to be lifted by the pulley?

This question and two others arising from it have been answered by a series of three experiments and a mathematical solution. The other questions are: Can a man lift a weight additional to his own on the loose pulley? With how much force must he pull upward on the chain? The answers and experiments were worked out by Mr. J. P. Drake, a physics teacher at the Kansas State Normal at Emporia.

Standing on a stone weighing 110 pounds, a man who weighs 190 pounds lifted himself and the stone by pulling upward on one end of a chain passed through a single pulley attached to the stone. The other end of the chain was fastened to a beam overhead. A spring balance on the chain on which he pulled registered the man's pull to be 300 pounds, which is equal to the combined weight of the man and the stone. However, when he pulled up with a force of 300 pounds his feet pressed down with an equal force on the stone, making the total load 600 pounds. In accordance with the principle of the loose pulley that each chain holds half the load, the supported chain held 300 pounds while the experimenter held the other 300 pounds as registered by the spring balance.

The mathematics of the experiment is as follows: Let $M = 190$ pounds, weight of man; $S = 110$ pounds, weight of stone and pulley; and R = man's reaction on the stone in pulling up on the chain with a force F. Then $R = F$. To support $M+S$ against the pull of gravity, $F = \frac{M+S}{2} =$ 150 pounds. But since the man stands on the stone, his feet press down on it with a force of 150 pounds. To overcome this reaction he must pull 75 pounds more. This added pull causes a reaction of 75 pounds down. To overcome this he must add, to the up force, $\frac{75}{2}$ pounds, and to that $\frac{75}{4}$ pounds, etc. The series becomes

$$R = F = 150 + 75 + \frac{75}{2} + \frac{75}{4} + \frac{75}{8} \ldots\ldots\ldots\ldots \frac{75}{\infty}$$

$$R = F = 150 + 75\,[1 + (\tfrac{1}{2}) + (\tfrac{1}{2})^2 + \ldots + (\tfrac{1}{2})^{\infty}]$$

But the sum of the geometric progression

$1 + \frac{1}{2} + (\frac{1}{2})^2 + \ldots + (\frac{1}{2})^{\infty}$ is known to be 2.

So $R = F = 150 + 75 \times 2 = 300$ pounds.

Accordingly, if the man pulls with a force of $300 + x$ pounds, half the excess pull of x pounds will be taken up by the rope running to the beam, and the other half can only be used up to produce the desired upward motion. So by the simple expedient of dividing his bootstraps in two halves and hanging one half to the top of the fence, a man really can lift himself over a fence by pulling on his bootstraps, after all.

A Mighty Twist

THE illustration herewith represents the effect of certain tests that are now made on steel pipe and the way such pipe successfully withstand these tests. The piece shown is from an eight-inch line pipe which has been subjected to a stress of 713,000 inch-pounds in torsion, that is, twisted under this force. The piece weighs about 29 pounds per foot and has a thickness of wall of about ⅓ inch. Ability to twist such a heavy pipe without developing any cracks or weak spots is indicative of excellent material.

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M.S.A.E.

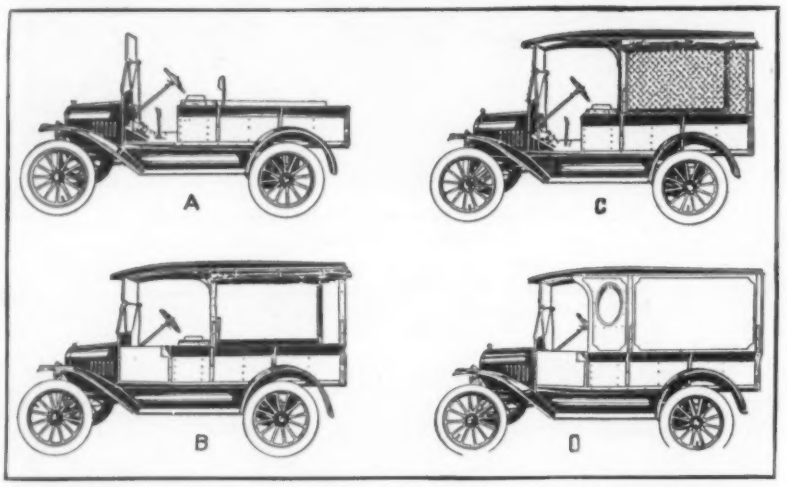
This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Unit Delivery Car Body Construction

THE systematic production of automobile chassis of various makes, in very large numbers, has given us thoroughly tested designs suitable for either pleasure or light delivery work. Formerly, the fitting of bodies was custom work and involved considerable fitting and trying before completion. The justification for this was the difference in the chassis that were brought to the body maker for conversion purposes. Just as soon as automobiles of certain makes were standardized, body makers were enabled to devise bodies for various kinds of commercial work that could be manufactured economically and sold at a price comensurate with that of the chassis to which they are adapted.

The bodies shown in the accompanying illustrations are based on an ingenious scheme of construction, in which units are added to a standard base to produce the type desired. As the units are put through the factory in large lots, costs are greatly reduced. For use in summer, the open side or screen side bodies are well adapted to the transportation of certain classes of goods that demand more thorough protection with the coming of the cold or unsettled weather. With the body shown at *B* it would be the work of but a few minutes to change the screen sides for solid panels and the change could be made by any man who can use a wrench and hammer. Another advantage is easy replacement of any broken part. A careless driver may damage a side panel by colliding with some object and even the most careful operator is liable to have an accident, through no fault of his own, in which a flare board or tail-gate will be damaged. With the unit construction, a new part can be obtained at small cost and may be readily replaced because the units are all interchangeable.

All bodies are built of steel with a steel skeleton frame which is said to make a body one-third lighter and two-thirds stronger than the equivalent all wood construction. The primary unit is shown at *A*. This is an open body with flare side panels and tail gate. It approximates the justly popular express type. By adding a canopy top with roll-up side and rear curtains one has the covered express body shown at *B*. The posts are attached to the outer edge of the flare boards and the full loading space is preserved. For light parcel delivery, the screen side body is very popular. This is obtained by adding stout screen panels to the body shown at *B* and the type shown at *C* is available. By substituting solid steel panels for the screens and putting quarter panels at the drivers' seat and full length doors at the rear, a completely enclosed body as shown at *D* is produced.



Unit delivery car body construction which facilitates economical production

Truck Saves Money Hauling Manganese Ore

FIFTY years ago manganese ore was in such demand that the owners of a maganese property in San Joaquin county, California, found it profitable to transport it on mule-back to Stockton, a distance of 32 miles. It was then loaded on river boats and carried 90 miles to San Francisco. At this point it was placed aboard sailing ships for a 15,000 mile journey to England, via Cape Horn. As new deposits of this ore were discovered in more accessible places the mine could not meet the prices of its competitors and the property was closed down.

A few months after the opening of the European War the price of manganese increased so much that mining interests purchased the property and reopened the mine. At first, the new owners invested $2,750 in transportation equipment, purchasing eight mules at $225 each; two three-ton bottom-dump wagons at $250 each and six sets of double harness at $75 each. Operating records show that the two mule teams could make three trips daily and haul 16 tons from the mine to the crushing plant, a distance of three miles. The cost of this hauling, including the wages of two drivers and one stable man, feed for the animals, repairing, shoeing, depreciation, interest on investment, taxes and insurance, totalled $17.07 a day. This was an expense of 32 cents per ton mile of ore hauled, 95 cents per ton of ore or $6.95 cost per trip.

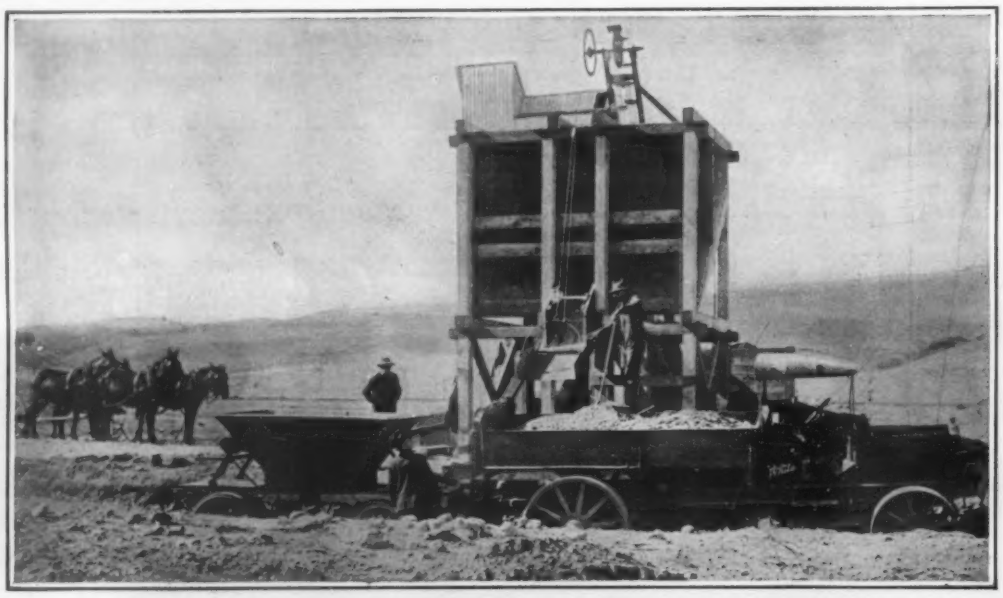
View of manganese mine showing character of roads over which the truck operated

The road over which the mules hauled their loads is black adobe. From the upper ore chute at the mine there is a 20 per cent grade to the main road which then skirts the mountain, twisting and turning down a 10 per cent grade for a distance of a mile and a half. Here a wash approximately a mile and a half square is encountered. It is the natural drainage of the surrounding mountains. In the summer the road is dusty, full of chuck holes and deep adobe ruts baked to a cement hardness by the burning rays of the sun. In the winter the ore wagons would often sink axle deep in the black quagmire and these conditions usually forced the abandoment of all activities during wet weather. For weeks after a heavy rain four mules could barely haul one ton of ore over these unfavorable roads. Two units of mule teams could not haul enough ore to keep the crusher busy. Eastern steel mills began demanding regular tonnage and later went so far as to offer attractive premiums to miners who could meet their requirements. The mine owner was unable to fill his regular contracts. He summoned a mining expert, who, after a careful analysis of conditions, recommended the purchase of a motor truck and a five-ton trailer to supplant the mules and three-ton wagons.

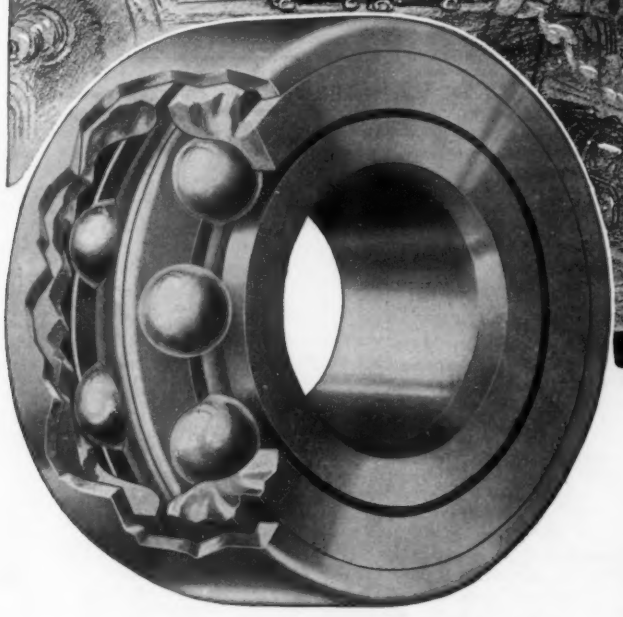
The new motor equipment cost the mine owner $7,825, almost three times the original outlay for the mules. But the truck and trailer were able to haul every nine hours a total of 80 tons of ore to the crusher and 80 tons of gravel for repairing the road. This equipment reduced the cost to four cents per ton-mile, 12.3 cents per ton or $2.47 per trip. The truck made eight trips per day, registering 48 miles. The total cost for operating the truck and trailer, including salaries of driver and helper, distillate, oil, grease, depreciation, interest, taxes, insurance, maintenance and repairs on truck and maintenance, repairs and tires for the trailer amounted to $19.77 per day. For 300 working days the motor equipment saved the owner $66.40 a day or a total of $19,671.05 a year, over the cost of performing the same work with the old facilities.

When the truck and trailer were delivered at the mine the rainy season was but 30 days off and it meant quick work on the part of the owner to place the roads in condition before the wet weather set in. Every ton of ore mined and not delivered to the crusher meant a loss of $25. To stop hauling ore and repair the road with the mule equipment was not practical. Building a road by ordinary means would have made necessary the hiring of additional men, wagons, and mules. The mule teams were taken off the job, a gravel elevator was erected in the creek bed near the ore crusher and the truck began its work of hauling both ore and gravel. The ore was loaded at the chute, transported to the crusher and dumped in less than thirty seconds. The truck was then driven to the gravel elevator where it was loaded with 10 tons of gravel and this, on the return trip to the mine, was spread along the road where required.

The truck and trailer with one driver and one helper completed the road in 26 days, while at the same time delivering all the ore that was mined to the crusher without interruption. Dangerous curves were straightened, culverts built, and the road improved in all ways. When the road was nearly completed the truck and trailer made a round trip, delivering ten tons of ore and gravel, in seventy minutes. The best that a four-mule team could do on the finished road, was to haul three tons of ore and return empty in three hours.



Loading the truck and trailer with manganese ore. Every day of nine working hours this effective transportation medium delivers 80 tons of ore to the crusher three miles away



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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of SCIENTIFIC AMERICAN.

Pertaining to Apparel

DISPLAY DEVICE.—C. H. MAC QUESTEN, 124 Ashland Ave., Bloomfield, N. J. The invention relates to merchandise for personal wear on display the main object being to provide means, by the arrangement of a mirror, whereby a person may view himself, as in the act of wearing the article on display, from the exterior of the show window, means being also provided that the observer may position himself with respect to the merchandise to produce the desired effect.

CONVERTIBLE COAT AND CAPE.—J. C. WHITESIDE, address Hodgman Rubber Company Tuckahoe, N. Y. The invention relates to wearing apparel, its object is to provide a convertible coat and cape, more especially designed for the use of letter carriers, messengers and other persons delivering mail, merchandise and like matter, it is arranged to protect the carriers bag against rain, snow or dust, at the same time leaving one arm of the wearer free to permit convenient removal of the contents of the bag. The cape may be detached and the coat worn as an ordinary coat.

Of Interest to Farmers

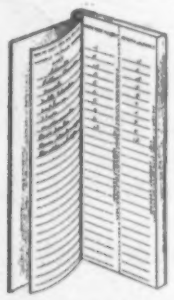
MILKING MACHINE.—M. L. NORRIS, 319 W. Jefferson St., Fort Wayne, Ind. The object of this invention is to provide a milking machine with compact units, and which may be readily cleaned, the units being supported by the teat cups which are attached to the teats of the cow, and serving to convey milk to pails or receptacles which may be disposed under the units.

TRACTOR.—W. SAVIDGE, 410 State St., Alton, Ill. The object of the invention is to provide a three-wheel tractor, with a supporting frame to which the power wheels are journaled, the frame supporting a driving shaft and a motor which drives the driving shaft in either direction, the shaft being connected to the power wheels to drive them from near the centers, the steering mechanism and reversing mechanism for the tractor is arranged to be controlled from the trailing truck or the machine, being operated by means of a single steering post.

PLOW DRAW BAR HEAD AND LEVELER FOR TRACTORS.—R. A. MORTON, 1101, The Wyandotte, Columbus, O. The invention relates to tractor-driven or motor plows, it has for its principal object to provide a draw bar head construction whereby the plow body is perfectly free to move either up or down or to one side or the other in order to pass around small obstructions in the soil, but is always maintained upright without any means other than the draw bar head, the plow may be adjusted from the operator's seat.

Of General Interest

LAUNDRY BOOK.—W. S. FREEMAN, Travelers Bldg., Richmond, Va. The invention has for its object to provide a book wherein a leaf is provided upon which lists of articles may be written, and a series of leaves, each partially divided into two portions that may be easily detached,



A PERSPECTIVE VIEW, WITH THE BOOK OPEN

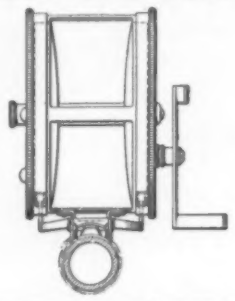
the said portions having spaces thereon registering with the spaces of the first named sheet for receiving the list of articles, the first portion of each leaf to be detached when articles are sent to the laundry with the book, the second portion to be detached when the articles are returned with the book.

CASE FOR JEWELRY.—T. CATALA, 90 Engle St., Englewood, N. J. The invention has particular reference to a jewelry case adpated for both storage and display purposes. Among the objects are to provide a case for rings or the like, so constructed that the article will occupy the minimum amount of space when the case is closed and will be held upright for clear display by the mere act of opening the case.

CONCRETE WALL CONSTRUCTION.—L. C. EGLOFF, 211 Rockford Ave., Forest Park, Ill. The object of the invention is to provide a mode of constructing concrete walls whereby to eliminate the erection of forms, this is attained by producing rectangular concrete slabs which are reinforced with flat steel bars. The reinforced bars protrude from the slabs and are arranged to receive interlocking and bonding devices connecting the front and rear slabs, at the same time interlocking the joining front and joining rear slabs. The space between the front and rear slabs is filled with concrete.

DEVICE FOR APPLYING SUBSTANCE TO TREES, SHRUBS, AND VINES.—W. R. KLECKNER, Cowell via Bay Point, Calif. The invention relates to means whereby an insecticide or other substance may be so applied to a tree, shrub or vine, as to readily enable the sap in the latter to take up the substance. The device is adapted to be applied to the tree at the sap wood after removing the bark to the necessary extent, the containing body of the device is provided with means for the entrance of the substance, so that it may be introduced into the device after the latter has been applied to the tree and sealed thereon.

FISHING REEL.—G. COOK, Box 44, Gillett, Wis. The invention has for an object to provide a reel having brake means designed to give better control to the reel while permitting a break to be applied thereto with varying pressure. The special feature of the invention is a brake pivot-



A REAR END VIEW OF REEL EQUIPPED WITH THE BRAKE

ally mounted on the reel beneath the casing and spool and acted upon by a spring normally holding the brake in release position. In the prefered form a pair of brake shoes engage the reel at each side, flanges are provided on the reel at each side to be engaged by the shoes, and the casing is provided with annular flanges to house the shoes.

HAIR MEASURER.—E. C. PECKHAM, 1705 Dorchester Road, Brooklyn, N. Y. An object of the invention is to provide a hair measurer and guide which is detachable, and which can be quickly attached or detached from a comb, which will enable one unskilled in hair cutting to cut or trim hair evenly and expeditiously.

CONTAINER.—C. A. HAMMOND-KNOWLTON, 118 E. 16th St., New York, N. Y. The invention relates to containers for protecting and acting as a feeding member for thread, the object being to provide a receptacle protecting the thread and for pinching the same as it is removed so as to produce a tension whereby the thread cannot accidentally become withdrawn into the receptacle.

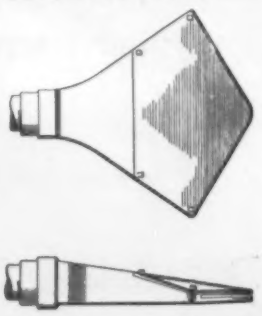
Hardware and Tools

SHEET METAL ROOF.—J. H. PERRY, 102 Academy Ave., Middletown, N. Y. The object of this invention is to provide a sheet metal roof arranged to enable a tinsmith or other person to readily join the metal sheets for forming the roof sides and the ridge without the use of solder, and to render the joints rainproof and thereby prevent leakage, use is made of metal sheets provided at each side with an upturned abutting member terminating in an inwardly and downwardly bent flange and a peak-shaped seam cup fitting over the flanges.

GARBAGE CAN.—J. I. LEVETT, 299 W. 150th St., New York, N. Y. Among the principal objects which the invention has in view are to confine disagreable odors and fumes, to prevent accidental dislodgement of the cover, to avoid handling the garbage, and to furnish the structure with a simple and efficient means for carrying the receptacle, a globular sectioned canopy pivotally connected with the body of the can, is used as a cover.

FISHING TOOL.—H. C. BREWSTER, care of Oil City, Iron Works, Shreveport, Louisiana. The object of this invention is to provide a sucker rod overshot, for engaging over broken or disconnected rods in well pipes or casings, the tool is so arranged that when lowered into the well it will, upon coming in contact with the sucker rod engage over the upper end of the rod, and lock the rod to the tool, in such a manner that the rod may be withdrawn from the pipe or casing, without possibility of accidental dislodgement.

STREET FLUSHING NOZZLE.—C. D. FARMER, G. N. FRAZER, SR., G. N. FRAZER, JR. and W. B. FARMER, care of Eugene Iron Works. One of the principal objects of the invention is to provide a nozzle for sprinkling or flushing machines designed to eject a stream of water to cleanse and wash a pavement in a manner more



TOP PLAN VIEW AND EDGE ELEVATION

thorough and advantageous than that attained by nozzles of ordinary construction. Another object is to provide a nozzle in which one of the parts may be removed so that the interior may be machined in finishing the nozzle, and whereby it may be cleaned without removing the nozzle from the sprinkling machine

Machines and Mechanical Devices

REVERSIBLE FOUR-CYCLE ENGINE.—J. KEISTER, Steubenville, Ohio. A specific object of the invention is to provide ports on the sleeve valve in such relation to the ports in the engine cylinder that the ports are thrown into or out of register simultaneously and automatic check valves are arranged in the inlet and outlet conduits, and in combination with this arrangement of ports and valves is used an ordinary circuit breaker which is so manipulated that the times of ignition can be adjusted to cause the engine to be reversed.

FIRE ALARM.—C. J. JENNE, 626 Bush St., San Francisco, Cal. The object of this invention is to provide an automatic fire alarm system comprising electric and pneumatic features so combined as to enable trouble to be located without sending in an alarm that will call out the fire apparatus, and wherein means is provided whereby the subscribers apparatus will indicate to him its condition, enabling him to either look for trouble in the apparatus or line or to look for the fire as may be indicated.

CLOTH STEAM SPONGING DEVICE.—C. A. WEISS, address, Geo. A. Mason, 114 E. 28th St., New York, N. Y Among the objects of the invention is to provide a steam generator adapted especially for treating cloth in clothing factories, and has particular reference to means for steaming various widths of cloth in a safe and reliable manner, the operation being performed with a minimum expenditure of time and fuel.

VENDING MACHINE.—E. A. CLAUS, care of W. M. Stone, Park Row Bldg., New York, N. Y. The invention relates to vending machines and has reference more particularly to check or coin-controlled machines for dispensing drinking cups. An object is to provide a machine for drinking cups or like, articles, which is compact in form, light in weight and comprises comparatively few parts, which is so constructed that it is not capable, without difficulty of unauthorized operation, and which when operated will dispense the contents one at a time only.

Medical Devices

HYPODERMIC SYRINGE.—F. S. DICKINSON, care of Becton Dickinson & Co., Rutherford, N. J. The object of the invention is to provide a hypodermic syringe arranged to permit convenient attachment of the needle with a view to prevent leakage at the point of attachment. Another object is to allow the needle to flex in a lateral direction thus prevent ng breaking of the needle in order to allow flexing the bore in the coupling is provided with a flaring mouth to allow the needle to flex and limit the flexing.

FOUNTAIN SYRINGE.—F. J. O ROURKE, 12 North 8th St., Whitestone, N. Y. The object of the invention is to provide a fountain syringe or douch bag whereby the user, or nurse in charge of a person can see at a glance when the liquid

FRONT ELEVATION OF BAG PROVIDED WITH THE INDICATOR

contained in the bag begins to flow out, and can gage the amount of liquid discharged. Another object is to removably attach an indicator in the form of a glass gage, to the rubber bag and to allow of removing the same, and using the bag without it when desired.

ABDOMINAL SUPPORT FOR MEDICAL AND SURGICAL USE.—S. A. WALTON, 8 Sheriff Road, West Hempstead, London, England. The invention relates to an abdominal support comprising a broad plate for contact with the body of the wearer, an elastic front plate secured to the front and middle portion of the contact plate, a back strip, and means adjustably connecting the ends with the contact plate, and curved plate springs secured to the front plate and their free outer ends projecting laterally and interposed between the contact plates and front plate.

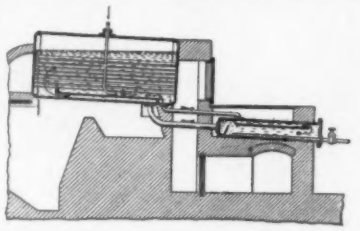
Musical Devices

SOUND CLARIFIER FOR SOUND PRODUCING OR REPRODUCING INSTRUMENTS.—C. W. JOHNSON, P. O. Box, 59 Penn Terminal, New York, N. Y. An object of the invention is to provide a sound clarifier consisting of a deflector located in the amplifying chamber and adapted to uniformly divert the sound waves transmitted upon the molecules of the air as an elastic body, and to intercept the counter currents or eddies in the axis of the amplifying chamber and thereby prevent unharmonious sounds.

Prime Movers and Their Accessories

OIL BURNER.—T. C. CURTISS, Sonora Apt., 2911 16th St., San Francisco, Calif. The main object of the invention is to provide revolving means for atomizing the fuel and for supplying air under pressure thereto after having been atomized actuated by the fuel itself delivered to the burner under pressure, as by the pump commonly used with such burners, a further object is to provide means for controlling the speed of revolution of the parts, for controlling the amount of fuel delivered to the burner, and for controlling the amount of air and the pressure thereof to be mixed with the atomized fuel.

CIRCULATING AND PROTECTIVE MEANS FOR STEAM BOILERS.—F. ILLESCAS, 2a Lucerna, No. 32 Mexico, Mexico. The prime object of the invention is to prevent the scale and other solid matter from being deposited on the bottom of the boiler thereby causing deterioration, of the latter, materially impairing its effi-



LONGITUDINAL VERTICAL SECTION OF A BOILER EQUIPPED WITH DEVICE

ciency, besides involving danger of an explosion, the invention provides protecting means that will prevent the deposits from being received directly upon the bottom of the boiler, and causes such a circulation as will prevent the accumulation of the deposits within the boiler.

HYDROCARBON BURNER.—H. A. LACERDA, 303 Campbell Ave., Schenectady, N. Y. The object of the invention is to provide a hydrocarbon burner for use in the fire boxes of boilers and other apparatus, arranged to convert the liquid fuel into combustable vapor. In order to produce the desired result use is made of a burner casing, a burner on the casing, and a fuel supply pipe connected with the burner casing, having a portion formed into a coil located above the burner and in close proximity to the flame issuing from the burner.

Railways and Their Accessories

RAIL-JOINT.—F. JERICH, address Geo. L. Broziah, Ely, Minnesota. The invention relates particularly to a rail joint in the nature of a combined chair plate and fish plate, the prime object being to provide an arrangement capable of efficient use in a temporary or permanent sense, the invention providing for the rigid support and connection of abutting rail ends without the employment of spikes attaching the plates to the rail ties, thus permitting the subsequent removal or permanent connection of the joint forming plates, in operative, relation with the rail.

Pertaining to Vehicles

SIGNAL.—W. CHAFFIN, 625 6th Ave., Huntington, W. Va. The invention has for its object to provide mechanism especially adapted for use in connection with motor vehicles for indicating to crossing policemen, drivers, and like persons, the intention of the driver of the vehicle to which the signal is connected as regards turning, going straight ahead, stopping, backing, or the like, and wherein the mechanism is so arranged that it may be connected to any vehicle without change in the vehicle, and may be operated by the driver from his seat.

VEHICLE TRUCK.—W. S. WILLS, Covington, Va. The object of the invention is to provide mechanism by means of which the power in a flexible type of motor vehicle may be applied to four or more wheels instead of two, to gain an increase in tractive power with the increased number of driving wheels and to lessen the actual power needed on the part of the motor to drive the wheels. A further object is to eliminate shock and jar, causing the vehicle to run more smoothly.

SPRING SUSPENDING MEANS.—D. MC RA LIVINGSTON, 159 E. 36th St., New York, N. Y. The prime object of this invention is to provide suspension means which will yield and respond to flexure of the spring but which will oppose endwise bodily swaying of the spring, hence prevent swaying of the spring supported super structure.

RESILIENT WHEEL.—H. C. ANDERSON, 2461 Frisby Ave., Westchester, Bronx, N. Y. The invention relates to that type of wheel in which there is provided a pneumatic cushion remote from the tread, and hence protected from all of the usual conditions which tend to cause damage or deterioration of the cushion. Among

A SIDE ELEVATION, PORTIONS BEING BROKEN AWAY

the objects is to provide a wheel including a rigid casing, in which is loosely housed a pneumatic tube, said casing being provided with openings through which the spokes project, a solid rim and tire being provided for the tread, also to provide means for excluding dust, dirt or other matter from the casing.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee title of the invention, and date of this paper.

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The Current Supplement

THE leading article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2181, for Octobe 20th, entitled *Homeomerisms*, discusses analogies that exist between physics and chemistry, and constitutes an important new department of scientific research. *A Ghost of the Past* describes and illustrates one of the curious old atmospheric engines, built in England over a hundred years ago, and which within recent years was still in operation at a colliery in Shropshire. The article on *Ferro-concrete Ships* tells of some examples of vessels built of this unique material abroad, and is illustrated by drawings of a ship recently built in Denmark. *Some Latter-Day Problems of the Foundry* discusses some new phases of long familiar questions, and others resulting from war conditions. *The Wrens* is a charming article dealing with a popular feathered songster familiar in this country, and it is accompanied by a large number of attractive photographs. *Building a Complete Cycle of Industries* tells what a railroad has done to develope the natural resources along its line. and forms an interesting technical story. The excellent description of *The Making of a Six-inch Reflecting Telescope* is concluded in this issue. It is accompanied by further detail drawings of construction, and should be read by every amateur astronomer, as it tells him how he can get an excellent and practical instrument at a trifling expense. *The Brown Coal Distillation Industry in Germany* is a technical article of considerable practical interest at this time. There are a number of other articles of value on many subjects.

The Passing of the "Pill-Box"

(Concluded from page 284)

German orders, depends largely on camouflaging the machine-gun posts. Earth removed in preparing posts must be thrown into unoccupied shell holes, or if the configuration of the ground permits, must be scattered on the surface. In this manner dugouts can escape aerial observation. The comfort of the scattered garrisons evidently interests the German High Command but little. They are told that if the humidity of the ground prevents the use of mine galleries, it will be sufficient to have simple shelters against shrapnel. Immediately behind the first line shell-hole centers of resistance for machine guns, dugouts should be available for shock troops and such reserves as have been sent forward, if possible; but failing in this they should be assembled and held in readiness in the open.

Barbed wire still plays a prominent part in this new German defensive scheme. Not only is a more or less continuous line used in front of the first-line shell holes, but it is used throughout the defense zone for directing the attacking troops into the most favorable positions for the German machine-gun fire. Furthermore, each "pill-box" and shell-hole position should be protected by a belt of barbed wire.

Villages should be avoided by infantry, and concentrations should be made in sheltered spots in the open, such as in shell holes, behind hills, in hollows, and in woods, the main point being to avoid detection by enemy airmen. The German High Command has learned by experience that villages draw enemy fire.

How these German plans worked out we all know from the recent British offensives. The very thing that the "pill-box" was intended to foil, tremendous gun-fire, has proved its undoing. For the British and French have merely doubled, tripled and quadrupled their gun-fire, thus increasing the probability of hitting each and every "pill-box" and machine-gun shell-hole position. And then the barrage fire has been greatly improved, until it seems impossible for enemy troops to stand up and fight after it has passed over them. But where the Allies have used the greatest sagacity is in the fact that each offensive is planned beforehand; every detail is carefully rehearsed; and the soldiers are assigned definite objectives which are well within the range of the artillery support. The last-mentioned fact answers the question so often heard: Why do the Allies only advance a mile or two at a time?

During the recent British offensives the barrage fire consisted of three distinct walls of shells and bullets: the heavy artillery, working at long range; the field artillery, working at short range; and the machine guns laying a curtain of bullets at a still shorter range. It is reported that the last-named barrage has proved most effective in practice; for when the British troops get beyond the field artillery barrage, as they do in some cases, the machine-gun barrage serves to good stead in checking counter attacks by German troops pouring out of dugouts in the rear.

If the development of artillery barrages has been a most difficult undertaking, the machine-gun barrage has been all of that and more. We are told that much patient practice has been necessary to adapt the machine gun to this work. It is more difficult to control the flat trajectory of the machine gun than that of the high-trajectory artillery piece. Therefore, many experiments had to be performed until it was decided how closely the bullet barrage might be safely applied. Now, with the machine-gun barrage perfected, the gunners following close on the heels of the advancing British infantry are able to maintain a hail of bullets before them, so that Germans essaying a counter attack are usually doomed to failure at the very start.

"Ferro-concrete will yield to our artillery just as the dugouts and trenches on the Bapaume Ridge yielded," stated Field Marshal Haig, recently, referring to the boasted strength of the German defenses in the so-called Von Hindenburg line. And his recent victories have borne out his predictions; for one by one the German "pill-boxes," crater posts, concrete dugouts, and other devices have yielded before a hurricane of fire. German counter attacks have been of no avail. And such block-houses and defenses as have not been wrecked by British shell fire have fallen before the assaults of the Empire's men, delivering in most cases big bags of prisoners. It is well to mention, too, the terrible effects of concussion from nearby shell explosions, on the occupants of concrete shelters, who, in many instances, have been killed without even being scratched. And then there are the "tanks," whose work is familiar.

The latest form of German defense has failed. Steel and concrete have failed to withstand the British artillery. We wonder what will be the next answer to Allied offensive machinery, and what will be its success.

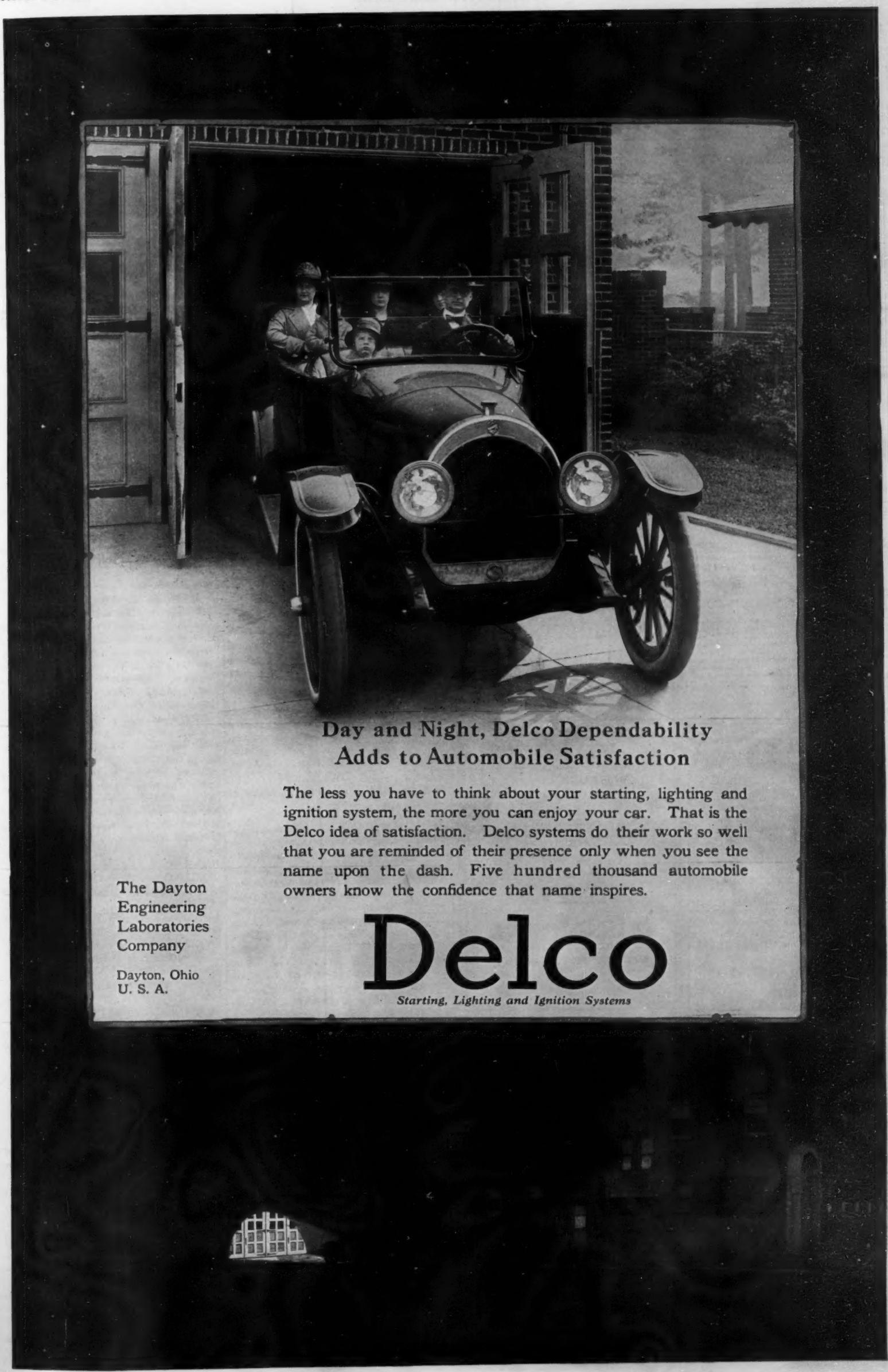
Mice by the Millions

(Concluded from page 291)

puts it, they "seem to have come into being almost in a few weeks."

The wheat is stored at the railroad stations throughout the colony, in bags, which must frequently be stacked in the open. The mice eat so freely of the grain that in their desperate efforts to obtain a change of diet they eat practically anything else in sight. The insulation on the telephone wires is suffering particularly in this way. The mice eat into the wheat from the bottom until they undermine the stacks, when the topmost bags fall and burst open, smothering great quantities of the little animals. Many men are employed to rebuild these demolished stacks, and a disease has appeared from handling the wheat with the dead mice in it, which in at least one case resulted fatally.

The plague seems to be increasing rather than diminishing. The mice are trapped by enclosing the wheat stacks in a double row of galvanized iron fence, with openings corresponding to the location of huge kerosene cans sunk in the ground. After eating, the mice must come out in search of water and instead of finding it are able only to locate the sunken trap. Several months ago a catch of 10,000 mice in a single night at Minyip was reported as indicating the extent of the visitations; but the picture which we present herewith throws this record completely into the shade. This gigantic heap of mice contains a four nights' catch at Lascelles, Victoria—five hundred thousand mice, over eight tons in weight.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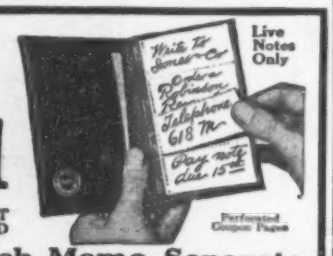

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Strategic Moves of the War, October 10th, 1917

(Concluded from page 286)

fear this advance, around which the safety or fall of the Dual Empire may revolve.

Some reports of fighting in Macedonia have come to hand, but not much can be expected here until the Allied armies, including Greek and Serbian forces, have been assembled and the plans of campaign fully settled upon. It is calculated that by next spring an army of one and a quarter million men will be ready, enough to begin forward movements. The plan is said to be to divide this army into two parts, one to advance up the valley of the Vardar River through Serbia or over the mountains to Sofia, the other to advance into Bulgaria and upon Constantinople. There are said to be 500,000 to 600,000 Allied troops in and near Salonica and it is claimed that 600,000 Greeks will be ready by spring fully equipped for service. The advance upon Bulgaria and Constantinople would undoubtedly be made by concentrating at Lagos Bay or Dedeagatch under the protection of the Allied fleets. The failure to make any decisive move so far this year in Macedonia has probably been due to preparations for the mobilization of such enormous forces.

No matter in what direction a move may be made, one of the primary objects of the Allies will be to cut somewhere the Belgrade-Sofia-Constantinople railroad so as to destroy all communication between Austria and Germany on the one hand and Bulgaria and Turkey on the other.

The first named countries have no doubt been obtaining large quantities of food and other supplies from Turkey and these can be cut off only by reaching the railroad. Greece has so far been sadly hampered in military preparations by the lack of proper equipment and supplies; but it is understood that both France and England have advanced funds and stores and our own country has already aided or will do so. It is not probable, however, that anything serious can be undertaken before spring. By that time Italy will have large bodies of troops in Albania that will force Austria to hold an army there; the latter country will thus be prevented from sending much relief to the Austro-German-Bulgarian armies now in Macedonia facing the Allies.

Potash—What We Are Doing About It

(Concluded from page 287)

coke in a blast furnace, volatilizing the potash as sulfate for later recovery. Unless some other marketable product can be obtained incidentally, however, the possibility of a profit is small under normal conditions. Many processes aim to produce Portland cement as the by-product, but the cement market is easily over-burdened. Others suggest the possibility of recovering silicon or alumina. A Canadian company using the blast furnace process is making tile and sewer pipe from the slag, and a Buffalo concern expects to grind it with slaked lime to make a slag cement. A hundred or more patents have been issued in this field, and much experimentation has been done.

Green sand or glauconite appears to yield up its potash more readily than feldspar, and is more cheaply mined. This material is found in the Atlantic coastal plain, and good deposits in New Jersey said to contain six per cent of potash are now being worked. One company makes a brick from the residue after extracting the potash.

In and around Sweetwater County, Wyoming, there is a large deposit of Wyomingite, a lava consisting for the most part of leucite. This also decomposes more readily than feldspar, and is being considered as a potash source by at least two concerns. The Geological Survey points out that the mill tailings at some of our western copper mines contain small amounts of potassium silicate, but commercial utilization has not yet been possible.

Organic Sources of Potash

The production of potash from wood ashes is one of the oldest of the chemical industries, and fifty years ago was practiced extensively in the United States. Instead of using wood waste as we do today timber was actually felled and burned for the ashes, as is still done in parts of Russia; and perhaps this accounts for the fact that by 1914 the industry had practically disappeared. Since 1915, however, a number of leaching plants have sprung into existence, generally in the hardwood districts like Wisconsin and Michigan. Hardwood ashes as a rule contain more potash than those from soft woods, though the content varies in different species and even in different trees of the same species. The ashes are collected from saw mills and planing mills where the waste is burned under boilers or in waste burners. The process of recovery is quite simple; the ashes are merely leached in a systematic manner with water and the resulting solution boiled dry. A ton of ashes will yield about 150 pounds of crude potash. Producers seem to prosper, but have difficulty getting the ashes. From the standpoint of present consumption only a small amount of potash can be got this way.

Many plant ashes likewise contain large quantities of potash, for instance cotton-seed hulls, sunflower stalks, cornstalks, and potato and tobacco stems. Thousands of banana stalks are thrown away in every large American city, and experiments have been conducted with the idea of using them as a source of potash. The dried stalks contain over 20 per cent of potassium oxide, and a ton of them—600 to 700 stalks—should yield 27 pounds of potash 90 per cent pure.

In Hawaii, where the pineapple canning industry flourishes, it has become a serious problem at some canneries to dispose of the waste tops and peelings. A successful disposal plant was installed at Honolulu in 1915 to meet the difficulty. After the extraction of sugar in commercial quantities the waste is incinerated with the production of an ash rich in potash. This may be leached like wood ashes, but is frequently used as fertilizer just as it comes from the kiln.

The sugar beet, like other vegetable matter, contains small quantities of potash, of which 90 per cent finds its way into the sugar solutions. When the sugar is crystalized out the potash concentrates in the molasses together with phosphoric acid and nitrogenous matter, also valuable as fertilizers. In converting the 6,000,000-ton beet crop of 1916 into sugar, about 350,000 tons of molasses were produced, of which slightly over half was used in stock feeding and the manufacture of alcohol. The remainder, containing possibly 7,000 tons of potash, was de-sugarized, and it is from the waste liquors of this process that potash would be recovered As these are very dilute the problem, although technically feasible, is economically a difficult one. Potash recovery from this source is practiced to some extent in France and Germany, but the investment necessary has deterred our companies from following suit. However, one concentrating plant is reported under construction, and others are being considered.

Distilleries using molasses as a source of alcohol waste daily 100 tons of potassium oxide. The waste liquors can be transformed into a dry powder containing nine per cent potash together with considerable nitrogenous matter. A plant has been equipped at Boston for utilizing distillery waste on a large scale and a factory at Agnew, Cal., is said to produce considerable potash from this source.

For some years it has been proposed to develop the giant kelp beds along our western coast. This giant seaweed was once used as a source of both potash and iodine along the shores of Normandy, Norway and Scotland; but iodine was the principal product, and with the discovery of better sources for this chemical kelp gathering went out of fashion. The potash shortage has brought it back. As told in the SCIENTIFIC AMERICAN of September 2d, 1916, potash from kelp is an accomplished fact. To the statement there made it is now possible to add the outlines of the process used by the largest of the California producers.

In large wooden tanks the kelp is allowed to ferment for several days with formation of acetic acid. The coarse matter is pumped off, and the liquor pumped to other vats, where lime and sodium sulfate are added. After being heated here and pumped to filters where the "mud" is removed, the clear liquor is evaporated in vacuo and allowed to cool in vats, with the result that a large proportion of the salts, consisting mainly of potash and acetate of soda, crystallize out. These are separated from the remaining liquor and dried for shipments. Acetone, which is a heavy ingredient of smokeless powder, is made from the sodium acetate; in fact, this is probably the chief product of the plant in question, which is operated by one of the large powder companies.

A further chapter in the utilization of kelp will be written as the result of Federal efforts. In August, 1916, the Government appropriated $175,000 for a full size plant to test the possibility of recovering potash and other products from this source by destructive distillation. The products obtained at this experimental plant are gas, tar, ammonia, iodine, charcoal and potash —the latter by leaching the charcoal. The gas is used as fuel to help heat the retorts.

There are a number of other sources of less importance. It has been proposed for instance, to work up the fish waters produced at menhaden factories. These contain ammonia as well as potash and might be evaporated with profit. Wool scourings were once an importan source of potash, and are still so used in some parts of Europe. This material is dumped into our streams at present, but the possibilities of recovery are being looked into.

The Present Situation

In 1915 our total production, valued at $350,000, was hardly more than a normal week's consumption. In 1916 it is estimated that about 10,000 tons were produced, valued at something like $3,500,000. The current year will undoubtedly show a considerable increase over this; it is possible that we will produce as much as 50,000 tons—one-fourth of our normal requirements.

In many chemical processes it has been feasible to substitute other materials for potash—notably the corresponding compounds of sodium This, of course, cannot be done when it comes to fertilizing the soil. As our methods of cultivation are much less intensive than those practiced in European countries we require fertilizers to a less extent, and there is no doubt that we can stand the potash shortage for a year or two more without suffering the pangs of starvation.

The most important sources of American potash appear to be in the cement and iron industries. A prominent cement engineer recently stated before an engineering society that it would be possible to recover yearly about 75,000 tons of potash (oxide) from the cement industry alone, and that with an investment corresponding to what Germany has put into her mines we could get another 125,000 tons from the iron furnaces. With the potash secured from the minor sources enumerated, we should then be independent.

Germany has an enormous investment in her potash mines and unless American producers are protected they will certainly be subjected to cut-throat competition after the war. However, even should low prices prevail for the German product, it is possible that transportation charges will make some of the domestic processes profitable in the interior of the country. Of course we want fertilizers as cheaply as we can get them, and if Germany can produce potash from her natural deposits at the lowest price to the consumer, it is idle chatter to suppose that we are not going to buy it of her. To protect us from another shortage, however, which might be more serious at a future period, it is to be hoped that at least some of the American producers will find the home industry profitable in spite of competition. The likelihood that this will turn out to be the case is appreciably increased by the opportunity presented to charge off the cost of experiment and plants against the

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Filling the Sugar Bowl

(*Concluded from page 289*)

boiling. At the proper stage, the mixture of crystals and liquid is run out and is ready to be separated into its two constituents, sugar crystals and syrup. It goes into a receiving tank and from this is drawn into the first centrifugal machine, where the syrup is spun off. The sugar remaining in the centrifugal machine is washed with filtered water, resulting in a clear product. It is then taken to a rotating dryer and after being dried, screened, automatically weighed and sacked is ready for shipment.

The syrup from the first centrifugal machine is taken to the second vacuum pan, again boiled to grain, dropped into a receiving tank and passed to the second centrifugal machine. Here the adhering syrup is spun off and the sugar washed as in the first machine. This washed sugar, however, is not dried but is dissolved, treated with sulfur dioxide gas and filtered. The clear, purified juice is then introduced into the first vacuum pan with the thick juice previously referred to. The syrup spun off from the second centrigufal machine is commonly called molasses. When this is not sold direct for stock feeding purposes, part of the sugar is recovered by the Steffen or the Osmose process. The entire process described, from the time the beets enter the factory until the finished sugar is put into the bag, requires 36 hours.

Unraveling the Skeins of Antiquity

AN expedition organized in coöperation between the Smithsonian Institution of Washington, and the Museum of the American Indian of New York, has just concluded its first season of excavation among the ruins of the Pueblo City of Hawikuh, in New Mexico. One of the famed "Seven Cities of Cibola," this place loomed large in the history of the Spanish conquest under Coronado and his successors.

Since 1670 the pueblo has been abandoned on account of Apache depredations. Considering the time since the village was forsaken by its inhabitants, the remains are in a remarkable state of preservation. Burials of three types have been found—remains cremated and buried with food and drink, others buried at length or in abnormal postures, usually dismembered, and still others deposited at length, head to the east, and with a very large supply of food, tools and ornaments. Among the skeletons found thus disposed of were several of members of the Priesthood of the Bow, with full war paraphernalia. In all 237 graves were opened.

The deposit of great quantities of food in the graves, while causing the bones to decay rapidly, had the opposite effect upon materials that more usually perish, such as baskets, fabrics and objects of wood; and many of these were saved by immediate treatment. Ornamental hair combs, ear pendants, and other ornaments of the most magnificent turquoise mosaic were found, which rank with the finest objects of this sort ever brought to light in America. The pottery possesses a wide range of decoration and color. Most of the designs are geometric, but conventionalized bird figures occur, as well as many life-like animal forms and plant pictures. The vessels consist chiefly of bowls, from tiny toy affairs to some as large as 15 inches across, in addition, however, were found large and small water jars, black undecorated cooking pots, duck-shaped vessels, and the like. It was the Hawikuh custom to "kill" all the vessels deposited with their dead by throwing them into the graves, and this was also the case with other household utensils.

An interesting discovery was the remains of great walls wholly beneath the Hawikuh refuse, which itself reached to a depth of 14 to 18 feet. It appears from this that the site was occupied in prehistoric times, long before the pueblo was built.

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Extending the Bill of Fare

WHILE the great food drive is on, it is interesting to note that not only are we increasing our efforts at production of recognized articles of food, but that we are as well constantly adding important foodstuffs to our menu. In our issue of September 8th, under the caption "Making Food from Fodder," we showed how this process works out, and we illustrated and described a number of grains which have but recently received credit as proper articles of diet for humans. The latest such addition to the list is really an old food product brought back after a long lapse; its sponsor insists that it was widely used in ancient Egypt, 6,000 years ago.

Emmer, the substance in question, is a cereal grain, cultivated for centuries on a small scale in Serbia, Russia and other countries, as well as in Egypt. The wild form was found growing on Mount Hermon, in Palestine, a few years ago by Dr. Aaron Aaronsohn. Since then it has been fairly well established that emmer is the original form from which other wheats have been developed. It was long thought by scientists either that the wild form of wheat was unknown and that these species would disappear from the earth if their cultivation should be stopped for a few years, or else that the einkorn found growing wild in Mesopotamia was the wild form from which wheat had been derived; but it seems that neither of these theories is well grounded.

The original wild emmer found on the arid hills of Palestine is no more like the improved domesticated forms than the wild crab apple is like the latest product of the gardeners skill. Prof. B. C. Buffum of Worland, Wyo., a Burbank of no mean experience, has been experimenting with this grain for 10 years. He reasoned that if it would flourish in such an environment as that of Palestine, it would surely grow well in the semi-arid regions of our west. With the dogged determination of the true scientist he devoted several years to experimentation. He was able to adapt the novel plant to the climate and altitude of the far west, but he found a great drawback to emmer to be its sharp, spine-like beard. By a long process of breeding and selection he overcame this, producing a beardless variety which remains so true to type that not more than one stalk in 10,000 reverts to the bearded type.

Emmer is particularly adapted to mountain and arid regions. It stands summer drought better than almost any other grain except the non-saccharine sorghums. The improved emmer has met with great success in the dry states. In eastern Colorado and other sections, farmers have reported successful crops, where drought had destroyed a large percentage of the wheat and other grains. One man reports 60 bushels to the acre of winter emmer and but five bushels of wheat under the same conditions. Another harvested seventy-five bushels of emmer where his wheat was a total loss. Under irrigation winter emmer has produced some phenomonal crops, as high as 150 to 180 bushels per acre; and the normal yield for the spring planting seems to be from 50 to 75 bushels.

Emmer is well qualified to take an important place as food both for livestock and for man. Chemical analysis, digestion experiments, and practical feeding trials have proved its value. It is a little richer in protein, carbo-hydrates and mineral matter than wheat, and about three per cent more of its protein and four per cent more of its carbo-hydrates are digestible in the animal stomach than is the case with wheat. This high digestibility applies equally to man and beast, and is due to the physical characteristics of the grain and its products. Emmer inclines toward hardness and brittleness, and the gluten in the flour does not become doughy and hang together in the same manner as the glutens of wheat products. Of course, if this characteristic is to be retained, it would be necessary to modify somewhat our ideas of how the cooked material should look; for bread of the standard kind could only be made from emmer by overcoming its non-cohesiveness. The feature just brought out, the perfect balance of the ration, and the high mineral content perhaps account for its being the one laxative known among all the cereals.

Emmer has been used as a human food in an unscientific way in several foreign countries for many years, largely as a breakfast food in Russia and as a bread grain in parts of Germany and Switzerland. The flour is particularly useful in the making of pancakes, buns, brown breads, puddings, gravies and the like, where a flaky, non-doughy condition is desired. The first emmer food products factory in America was built at Worland, the home of American production of this grain. Its success was so complete that a reorganization and enlargement of the company has recently been made, and a second factory is projected for Denver.

How the Trackless Trolley System Fares in Actual Service

RAILLESS trolley traction has proved a success in Bradford, England, and has been operated at a profit by the municipality. The low capital expenditure (one-tenth that required for the ordinary tramway system), has enabled many rural and suburban communities to obtain a passenger service at moderate cost.

The trackless car is regarded as a pioneer service preceding the installation of an ordinary trolley route and serving as a feeder for Bradford's main electric transportation service. Its primary function is to tap the thickly populated areas, serve them until their development requires a permanent way, and then move on to new areas. Another important function performed by the trackless cars is in forming connecting links between the terminals of existing trolley lines and facilitating rapid communication in the network of lines operated by the municipality.

The first trackless trolley service in Bradford was installed in June, 1911. There are now five such routes operated by the municipality, comprising a total mileage of 9½ miles. The statistical return for 1916 showed a car-mileage on the railless system of 322,390, as against 177,653 in 1915. The total operating cost for the 18 cars in use (including interest and sinking-fund charges) was $0.1555 per car mile, and during the last calendar year (1916) the number of passengers carried amounted to 3,402,985. Half fares are charged before 9 A. M., the lowest charge being $0.01, and special reduced fares apply to children going to and from school. The route is divided into stages, and the fare is according to the distance traveled. The average fare per mile is $0.013.

Each car has a seating capacity of 29 persons, and a crew of two, consisting of motorman and conductor. The current is obtained from overhead trolley wires, and the vehicle runs along the highroad on solid rubber motor-truck tires. At the terminus the cars are turned, without removing the trolley connection, by means of an overhead trolley reverser of triangular shape. The cars are said to be less noisy than the gasoline-driven motor busses, and the absence of objectionable odors is an advantage. However, they do cause considerable damage to the roads over which they run, and the highways require regular attention and care, a smooth road being a prerequisite to successful operation. The macadam and concrete types of road construction are favored in the environs of Bradford, where large supplies of good road-making stone are available.

Although railless traction is financially a success in Bradford, an exact statistical return is misleading, inasmuch as the "feeding value" is not and can not be taken into consideration in the accounts for railless traction in contradistinction from the municipal systems as an entity. The routes along which the cars run are often routes upon which rails could not be laid without heavy capital expenditure, and this method of transportation, it is stated, was adopted originally because of cheapness in construction and operation rather than by reason of any other advantage over the undoubtedly superior service afforded by ordinary electric railways.

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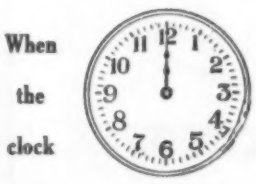

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Referring to the relative merits of gasoline-motor busses and railless electric traction, a recent report by the Bradford Corporation Tramway Department states: "The former would have been an alternative; but, judging by the published cost of various motor-omnibus enterprises throughout the country, we are running railless cars at a less figure per car mile and giving an equal, if not a better, service. The total 'all in' costs per car mile as between bus and trolley car are governed to some extent by the density of car miles per mile of route operated."

No freight business or goods and parcel delivery system is in operation on the railless trolley lines. However, it may be pointed out that on the electric street railways of Bradford an excellent parcel-delivery system has been in successful operation for a number of years, and an innovation in the matter of goods transportation recently had its beginning in the use of a truck operated between the schedule of ordinary trolley-line service. This truck is run on the trackless-trolley principal, but an important additional feature is that it is fitted with accumulators which will take their supply of current from the overhead wires and enable the vehicle to leave the tramway route at any point in order to reach its destination and deliver goods.

Corn That Can't Be Killed

IN the circular flower bed before the main entrance of the Natural History Museum in New York, garnished with a sign reading "Corn—Not Tulips," a war garden was planted and a crop harvested. It amounted to several pounds of maize of a variety strange to the east, but well known to the earliest farmers of the northwest, the Mandan Indians. In eastern Montana the acreage of corn descended from the Mandan maize will probably double this year. This is a clear net gain to the nation's food, for the Mandan corn is being raised on land which would otherwise be producing no food whatever. Large numbers of farmers are of the opinion that the growing of Mandan types of corn is the greatest single factor in successful agriculture under the semi-arid conditions of the eastern slopes of the Rockies and the plains leading up to them. It is predicted that the Mandan corn acreage of the plains section of Montana will before long rank next to that of wheat.

The corn in question is described as the earliest fruiting type known, and one that will stand more hardship in the way of drought, backward seasons, wind and neglect than any other variety. Under conditions that would destroy any other corn, this stock will produce ears maturing in from 70 to 90 days. The stalks are fine and short, with many branches or suckers and they bear many ears. There are several varieties, both flint and starchy.

The history of this corn indicates how facts of value can be learned from primitive people whom we are tempted to regard as ignorant. While white settlers were insisting that corn could not be grown with success in northern Iowa and South Dakota, the Mandans were doing that very thing in Montana, where the unfavorable conditions were greatly increased. For hundreds of years the selection of the seed corn had been going on, season after season, under the direction of the Medicine Men of the tribe. Though they made a religious ceremony of this as of so many other things, it was nevertheless performed on approved scientific principles. Ears were selected not only for their perfection but also for their earliness in maturing, and the result of this selection was a corn that requires a shorter season than any other.

The seed corn was held sacred, the different varieties were kept separate by various families and groups, and thus the purity of the strain and its improvement was fostered by savages who had never heard of scientific methods of developing desirable qualities, but who did the right thing by instinct. The maize which matures in the northwest in 70 days, with comparatively little heat, was developed from a plant which in the tropics requires four months to ripen.

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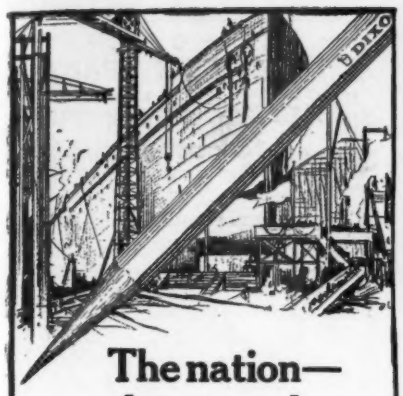

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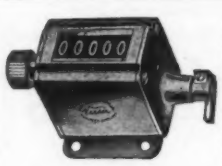

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NEW BOOKS, ETC.

STORAGE BATTERIES SIMPLIFIED. By Victor W. Pagé, M.S.A.E. New York: The Norman W. Henley Publishing Co., 1917. 8vo.; 320 pp.; illustrated. Price, $1.50.

This is a most comprehensive discussion of the action, maintenance, repair and use of that important accessory, the secondary battery. All its industrial uses are outlined, with simple explanations of the way in which the modern battery operates street cars, locomotives, automobiles, submarines, lighting plants, switch and signal systems, and various other mechanisms and installations. There is an amply illustrated exposition of the leading types, prevalent defects are cited, and the processes of restoration are summarized. Charging methods are carefully explained, and there are special instructions for the care and repair of the automobile battery Avoiding technical language, it constitutes an excellent guide for the general reader, contributing to battery economy and eliminating much of the inconvenience due to ignorance of simple principles.

HOW TO RUN AN AUTOMOBILE. By Victor W. Pagé, M.E. New York: The Norman W. Henley Publishing Co., 1917. 8vo.; 178 pp.; 72 engravings. Price, $1.

The experience of the expert is here crystallized into practical lessons for the amateur. Automobile construction is outlined in one short chapter; after that the discussion is strictly confined to operation and care. From this non-technical elucidation of basic principles and leading control systems, the beginner may make himself familiar with the mechanisms and methods of all leading makes of car; the operating instructions of the leading manufacturers are incorporated in the volume, and control groups and dash assemblies of various types are clearly shown in the engravings, with each part plainly named in the cut. The final chapter deals with the winter care of the car, the maintenance of body finish, tops and upholstery, care of the storage battery, the tools and repair equipment, motor troubles, road repair of tires, and the extrication of the mired machine. Simplicity and thoroughness mark all the explanations which, once mastered, will lead to added comfort, safety, economy and efficiency. The author possesses not only the necessary knowledge, but also the rarer faculty of expressing himself so that the non-technical reader cannot fail to understand.

EXPLOSIVES. By Arthur Marshall, A.C.G.I., F.I.C., F.C.S., Chemical Inspector, Indian Ordnance Department. Philadelphia: P. Blakiston's Son & Co., 1917. 8vo.; illustrated. Two volumes. Price, $16.

The second edition of this substantial and valuable work uses much new material in text and illustration; this has made necessary its separation into two volumes. The first volume is devoted to the history and manufacture of explosives; Part I consists of a new introduction and three historical chapters that bring the progress of explosives down to the present time; Part II deals with the manufacture of saltpetre, charcoal and sulfur, and gunpowder; Part III with acids—sulfuric, nitric and mixed and waste acids; Part IV is devoted to the nitric esters of carbohydrates, the manufacture and stabilization of nitrocellulose being described in detail; Part V takes up the nitric esters of glycerine; Part VI treats of nitro-aromatic compounds; Part VII of smokeless powders, and Part VIII of blasting explosives. This summary of contents will give some idea of the scope and helpfulness of the volume, while the reliability of the work is guaranteed by the standing of the author. Volume II, which is to be ready in June, will deal particularly with properties and tests of explosives, and will have chapters on various special explosives; additional tests for detonators will be found, with information on the chemical analyses of explosives and their constituents and rules for calculating the additions to be made in revivifying waste acids.

DISEASE IN MILK. The Remedy: Pasteurization. The Life Work of Nathan Straus. By Line Gutherz Straus. New York: E. P. Dutton & Company, 1917. 8vo.; 383 pp.; illustrated. Price, $2.50 net.

Mrs. Straus has a definite, avowed aim in the compilation of this volume. It is a monument, not to a dead personality, but to a living work—the task of saving the babies born into the world; and her hope is that others may be stimulated to take up and carry on this most humane enterprise. The results obtained in New York City by Mr. Straus and pasteurization show a presumptive saving of many thousands of young lives; since the establishment of the Straus service the mortality of children under five years of age has dropped from 96.2 to 34 per thousand per annum. Instructions are given for making a simple apparatus for the pasteurization of milk in the home; the life work of Nathan Straus is set forth in all its amazing aspects, and there are tributes from distinguished physicians, Government authorities and celebrities. Throughout the volume one fact is emphasized in every possible way: that pasteurization immunizes milk without depriving it of its vitamines or its food value, and without impairing its taste or digestibility. Among the diseases transmitted by raw milk are typhoid fever, diphtheria, scarlet fever, and tuberculosis; and the pedigreed cow, far from constituting a guarantee of safety, carries with its aristocratic lineage a special susceptibility to tuberculosis.

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14248) C. J. S. of Query 14207 is informed that the Foucault Shadow Test is described in a little book "Glass Working by Heat and Abrasion," written by *Hasluck*, which we can supply for 50 cents postpaid.

(14249) G. D. H. asks: On pages 953 and 954 of the SCIENTIFIC AMERICAN *Cyclopedia of Formulas:* freezing solution formulas are given. I would like to make a freezing solution to freeze about 1 gallon of oil. I do not understand how to make the mixtures, and after the mixtures are made how long will they last? Please give me any information on the subject which you can, also how the freezing is accomplished or what the chemical action is? A. The making of a a freezing mixture is a simple matter. The ingredients should be weighed out separately and then stirred together in a wooden box or pail. A metal dish containing the article to be cooled should be quickly surrounded by the mixture, and all heat kept out. The freezing is done by melting the substances in the freezing mixture. It requires heat to melt them and that heat is taken from the substance to be frozen. In freezing ice cream, salt and ice are mixed in the proportion of 2 parts ice to one of common salt, as in Formula No. 1, on Page 953 of the *Cyclopedia*. Heat is taken from the cream to melt the ice and salt. The salt causes the ice to melt, but this would not take place excepting heat could be obtained to melt the ice. The heat is taken from the cream in the freezer. The outside wooden container prevents the heat from being taken from the air. There is no chemical action in a freezing mixture. It is simply a melting of something. In most of the formulas snow is melted.

(14250) B. S. G. asks: Kindly give information on the following points: 1. What is meant by the tonnage of a vessel? 2. How do the different miles (statute, sea or nautical) differ? 3. Explain the different subdivisions of an army, as company, platoon, brigade, etc., and give the name of the commands of each? 4. How do gas masks let in air and keep out gas? 5. Explain the membering of submarines, as U-53, L-25, etc.? 1. Tonnage of vessels is expressed in several different ways. There is the "displacement tonnage" which is the amount of water actually displaced by the vessel when at the load water-line. There is the "gross tonnage" which is customarily the entire cubical volume of the vessel in gross tons, allowing 100 cubic feet per ton. There is the "net tonnage" which is the gross tonnage minus the space allotted as sleeping quarters. There is the "register tonnage" which is measured according to the laws of the United States. There is "Suez tonnage" which is the tonnage allowed by the Suez canal authorities according to their established rules. These are a few of the many different systems of measuring tonnage. 2. A nautical mile is the distance subtended by one minute of arc on a great circle of a sphere whose surface area is equal to the surface area of the earth. This distance, as adopted by the U. S. Coast and Geodetic Survey is 6080.27 feet. A statute mile is 5,280 feet. 3. Without going into the accepted balance of infantry, artillery, cavalry, engineers, etc., making up an army the following is the manner of subdivision:

Unit	Strength	Commander
Army	2 or more army coprs	General
Army corps	2 or more divisions	Lieut.-General
Division	3 brigades	Major-General
Brigade	3 regiments	Brigadier-Gen.
Regiment	3 battalions	Colonel
Battalion	4 companies	Major
Company	2 to 4 platoons	Captain
Platoon	40 to 50 men	Lieut. or Sergt.
Squad	8 men	Corporal

4. There is a large variety of gas masks in use. The most satisfactory, so we are informed, is the type in which the air supply to the wearer is led through a cartridge charged with chemicals which have a strong affinity for the gas encountered. 5. The letter in the identification of a submarine designates the type of submarine and the number designates the number of the particular boat of the type.

(14251) C. M. G. asks: Through your Notes and Queries please answer the following: Regarding the first use of steam to do the work of men or beasts, I understand that Newcome or some name similar was the name of first engine used to pump water from coal mines, taking place of horse sweep: also I hold that steam was allowed to enter the space behind piston when pump rod was down with a charge of water on top of pump plunger ready to be raised and discharged, water was introduced into steam space condensing the steam, forming vacuum which allowed atmospheric pressure to force steam piston up and bringing the water with it; with piston at top of stroke valve was opened and steam at atmospheric pressure allowed to suck in as water plunger sank for fresh charge, steam being used indirectly to pump, no pressure was used and atmospheric pressure alone did the work. My opponent believes that steam under pressure was used and water used also for condensing to pu.l or force pump plunger down for fresh charge of water, working on walking beam system; the steam under pressure moving steam piston on the water lifting stroke while vacuum aided in return stroke. I presume we are both n error more or less; I think we are lame on the name; was it not Newcomen? I have searched my books but cannot find the place where I read it, although the facts as I gave on my side seem to stand out very d'stinctly: A. The Newcomen engine worked a pump by a walking beam. The cylinder stood on the top of the boiler, open to the air at the top, and the piston moved up and down in the vertical cylinder. Steam was admitted into the cylinder to drive the piston up and lower the pump rod into the well. Cold water was then admitted into the cylinder and the steam condensed, thus forming a partial vacuum under the piston. The pressure of the air on the upper surface of the piston pushed down the cylinder and lifted the pump rod in the wall, thus raising the water. This engine is usually described in text books of the engine. It is fully illustrated in Ewhank's Hydraulics and Mechanics, a very old book, long out of print. The steam was not the prime mover which directly did the work of raising water. Atmospheric pressure raised the water, due to the vcuum formed under the piston by the condensation of the steam. The valves were opened and closed by hand. Neither of your statements of the action is wholly correct. Of the Newcomen engine the Encyclopedia Britannica, 11th edition, Vol. 25, page 819, says, "Steam admitted from the boiler to the cylinder allowed the piston to be raised by a heavy counterpoise on the other side of the beam. The steam valve was shut and a jet of cold water entered the cylinder and condensed the steam. The piston was forced down by the pressure of the atmosphere and did work on the pump. The next entry of steam expelled the condensed water from the cylinder through an escape valve. The piston was kept tight by a layer of water on its upper surface. The engine used steam whose pressure was little if at all greater than that of the atmosphere; sometimes, indeed, it was worked with the manhole lid off the boiler." It is thus evident that the water was raised by the pressure of the air against a partial vacuum formed by condensing the steam in the cylinder by the introduction of cold water in a jet. The counterpoise raised the piston, the steam flowed up into the cylinder as the piston moved up, and when the cylinder was full of steam at about atmospheric pressure, the jet of water condensed the steam and produced the vacuum so that the air pressure on the outside of the piston pushed it down raising the water and the counterpoise to make it ready for the next stroke. The valves which controlled this intermittent action were turned by hand. Thurston's Growth of the Steam Engine, Price $2.75 give a similar account.

(14252) F. U. R. asks: Please answer, if possible, through your Notes and Queries columns the following and oblige: 1. What is fall of the waters of the Niagara Falls? 2. At what speed does the water of the Susquenhanna River of Pennsylvania travel, also of the Mississippi River. A. The mean fall of water at Niagara on the Canadian side is 155 feet; at the Terrapin Tower, which is about the middle of the falls, it is 161 feet; at the east bank of the American Falls it is 169 feet. The water is believed to be 20 feet deep on the Canadian side. There is a slope in the rock of about 14 feet in the width of the river. The speed of flow of rivers varies very greatly in different parts of their course. We have no figures for the rivers you name. The Coast and Geodetic Survey, Washington, D. C. can probably supply you with figures, at selected points.

(14253) R. S. R. asks: To settle an argument will you kindly state in your issue of the twenty-fifth whether black and white are considered colors. A. Black and white are not colors. A white surface reflects all colors equally, a black surface does not reflect any color. Pictures in black and white are called drawings and not paintings.

(14254) L. C. A. asks: Have you ever published a formula for making *lamp dip*, for coloring electric light globes. A. Aniline dyes are used for coloring the bulbs of incandescent lamps. The dye is made by dissolving the aniline color in alcohol, and mixing it with shellac varnish, to the desired tint. A better adhesion may be had by dipping the bulb in a solution made by mixing the white of an egg in a pint of water and letting it dry on the bulb. A second dipping ensures a more complete covering. The lamp must be clean and perfectly dry when it is dipped.

(14255) G.I. M. asks: I would like to have your Electrical man tell me how I can figure amperage per horse-power at voltages of 110–220–440 A.C., and also 115–230 D. C., would also like to have some information on coil and armature winding on induction motors. A. To find the horsepower of an electric motor, if the current is direct, multiply the volts by the amperes and divide the product by 746. If the current is alternat- you must multiply also by the power factor. There are meters which give the power factor as another meter gives volt or ampere readings. We can supply you with the following books on armature winding: Arnold's Armature Windings for Direct Current Dynamos, price $2.00; Horstmann and Tousley's Practical Armature Winding, Price, $1.00.

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